**Calculation Algorithm to Determine the Number of Drops Reaching the HydroSensitive Paper from the Machine STIHL SR 420 Spray**

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**Abstract**

In this paper it is studied the possibility of counting the number of drops which fall on WSP after watering with the atomizer STIHL SR 420 with the aim of establishing some proper work parameters such as: optimization of the liquid norm, observing the uniformity grade, the number and diameter of drops for achieving an optimal treatment.

The reduction of the polluted environment in the damaging of the disease and pest control will be done, mainly, throw the reduction of the liquid norms per hectare, using spraying system at which it can be control and manage the size of the drops as the distribution of these on the vegetable.

**Keywords:** spraying devices, uniformity level, spraying, optimal handling, drift

**INTRODUCTION**

In all the countries it is demonstrated a high interest stand for the modernization of the work’s action meant for saving the culture. The right issues obtained in the field, can be given, in a large measure, due to the effort sent for the mechanization for the specificity works. This institution is presented on a variety rage of machines and installations which permit the distribution of the biopreparation, known as ecological product of the damaging pest control.

The machines form this range are majority with pneumatic spraying of the toxic material. The advantages that are offered by this machines category is consist of: the low volume of exploitation, simple construction, easy harming, safety exploitation, delicately spraying, high uniformity of the treatments, reduce consumption of toxically material at hectare and acquisition conveyable cost according to the other category of machines at the same destination.

Another way is using the optimal technology, which throw the formed drop spectrum and also throw its vegetation deposit allow to obtain a high efficient of the treatment.

The reduction of the polluted environment in the damaging of the disease and pest control will be done, mainly, throw the reduction of the liquid norms per hectare, using spraying system at which it can be control and manage the size of the drops as the distribution of these on the vegetable. (Stahli, 2003a, 2004)

The main parts are considered to be the spraying machines of any technical spraying equipment, that’s why it is until now a big diversity of spraying system.

The pneumatic spraying functioning principal is relative easy: trend airs with high speed stimulates and spray the liquid at the exit of the supply tube of the spraying.

In our country it is a good endowment with machines carried by men, having the own action form the own engine. A better representation is the models:
As an answer to the exigencies of the modernization of the sapling nursery, on general retain surfaces, interested the machine model Stihl SR 420 and the possibility to adapt them for the multifunctional utilization at fitoprotection. Their working possibilities were less studied from the theoretical point of view and also from the applied point of view. (Popescu, 1984, 2000)

It is going to be rise the verifying problem of the proper functioning of the machines for pouring with experimental character in the lab to see some optimal parameters of work.

MATERIALS AND WORK METHOD

Materials

The Equipment

For the doze regulation in the case of pneumatic spraying it can be used orientable the instructions included in the technical file of the Stihl Company.

The machine model Stihl SR 420 is made in Germany and it is used mainly for the mechanization of the works for damaging the pest as well as the human and the veterinary hygiene (disinfection actions). In comparison to other machines of the same size group, all the technical operations that could be done by these machines is much larger. So, without essential changes, the machines can be used for scattering the granulated mineral fertilizer and the biomaterials.

The spraying regime is the following: the sprayer uses the air as a supplementary way of transport for the active substance. A blowing engine produces a very concentrated air flow which guides the solution (the active substance in the carrying liquid) through a dosing system. So the solution is atomized in very fine drops and it is carried very fast by the air flow. (Stahli, 2003b)

Due to the corresponding configuration of the sprayer, the formed drops cover a size spectrum of approximately 50 to 250 µm (thousand of millimeters). The air can be speed up with an expenditure of energy much more reduced than water, the sprayers having in this way a high efficiency (a large operating range to a lower operating power and to a small weight).

For the covering of the using spectrum, the machines have as a force source an internal – combustion engine with a single cylinder in two steps, chilled with air, which have the following technical data:

<table>
<thead>
<tr>
<th>No.</th>
<th>Technical data</th>
<th>Machine: Stihl SR 420</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.</td>
<td>Thermic engine.</td>
<td>2 steps</td>
</tr>
<tr>
<td>2.</td>
<td>Power.</td>
<td>2,5 kW</td>
</tr>
<tr>
<td>3.</td>
<td>Cylinder displacement.</td>
<td>44,9 cm^3</td>
</tr>
<tr>
<td>4.</td>
<td>Engine rotative speed.</td>
<td>8000 rot/min</td>
</tr>
<tr>
<td>5.</td>
<td>Combustible.</td>
<td>Mixture of petrol/oil (1:50)</td>
</tr>
<tr>
<td>6.</td>
<td>Solution holding capacity.</td>
<td>14 l</td>
</tr>
<tr>
<td>7.</td>
<td>Air speed.</td>
<td>80 m/s</td>
</tr>
<tr>
<td>8.</td>
<td>Exhausted air volume.</td>
<td>18 m^3/min</td>
</tr>
<tr>
<td>9.</td>
<td>Horizontal action area.</td>
<td>12 m</td>
</tr>
<tr>
<td>10.</td>
<td>Vertical action area.</td>
<td>11 m</td>
</tr>
<tr>
<td>11.</td>
<td>Spreaded material flow.</td>
<td>0,14 – 3,03 l/min</td>
</tr>
<tr>
<td>12.</td>
<td>Weight.</td>
<td>11 kg</td>
</tr>
<tr>
<td>13.</td>
<td>Combustible holding capacity.</td>
<td>1,5 l</td>
</tr>
<tr>
<td>14.</td>
<td>Air filter</td>
<td>Paper filter</td>
</tr>
<tr>
<td>15.</td>
<td>Flow degrees.</td>
<td>6</td>
</tr>
</tbody>
</table>

The setting up of the toxic liquid flow of the machine model Stihl SR 420 can be done through a tap which has a spiral cut, and at its end it has an adjusted orifice of 5 mm diameter and it can occupy one of those 6 positions. In the first tap position the flows are of 0,14 l/min; in the second tap position the flows are of 0,71 l/min; in the third tap position the flows are of 1,33 l/min; in the fourth positions the flows are 2,09
l/min; in the fifth position the flows are of 2.67 and in the sixth position the flows are of 3.03 l/min. (Source: The Catalogue of Stihl Company).

A main advantage is that at the end of the deflector tube, the machine has a charger with two exits, in two different parts of the liquid and two rings which produce a turbo effect.

Hidrosensitive paper.

The aspect of the spraying uniformity and the covering grade was highlighted with the help of the water sensitive paper made by the Spaying Systems Co.

The properties of the sensitive paper help it to answer well to the interaction with the water drops, the touched area is colored in blue-greenish tint. The standard dimensions of wsp made by Spaying Systems Co. are: 26x76mm.

Work method

The processing of wsp resulted after watering was done through the picture analyses. For this, all wsp patterns had to be scanned with a HP 2400+ scanner and, afterwards, they were processed after the following algorithm:

The aim of this algorithm is to separate the blue-greenish drops of water from the yellow Water Sensible Paper; all these digitally at a resolution of 0.001792111 (mm²) resulted from the digital scanning of WSP at a resolution of 600X600 pixels per inch (1inch=25.4 (mm)), as in the example from picture 1.

\[
\begin{align*}
WSP_{i,j} &= (R_{max} \cdot G_{min}, 60, G_{max}, B_{max})
\end{align*}
\]

where Max=max(R,G,B) and Min=min(R,G,B), and H[0,360]. The result of this change is also a matrix 

\[
\begin{align*}
WSP - H_{i,j} &= \frac{255}{360} \cdot nL, j \cdot 1/nC
\end{align*}
\]

which is shown in picture 2 and which has its definition area [0,255] to be shown in grey scale.
The digital separation or the color filtration require the performance of the colors bar chart of WSP_H image to determine the bordering limits of yellow color of an idle WSP and of green and blue colors which mark the WSP "watering" – picture3.

From this bar chart of colors the limits of yellow color [35;50] can be picked up and also those green-blue colors [51;95] which define "the watering" with WSP water drops.(Boja F, 2008)

The separation of water drops from the yellow support is done through a digital filtration defined by the formula:

\[
WSP_{BW_{i,j}} = \begin{cases} 
1:195 & H_{i,j} \in [35;50] \\
0:50 & H_{i,j} \in (51;95) \\
0:96 & H_{i,j} \in (96;255) 
\end{cases}
\]

it results a matrix defined by two Boolean colors with values “1” (white) – water drops and “0” (black) on the unaltered WSP, shown in picture 4.
Afterwards the water drops will be labeled and its surfaces will be measured. Finally, it is determined spontaneously the number of drops, their individual surfaces, the covering percentage (27.1499% for the taken example) and the bar chart of the drops surfaces from the WSP (picture 5) can be done; all these can be stored in an MS Excel file for the other statistical processing.

The processing of the images obtained through the WSP scanning permitted the arrangement of the watered surfaces and of those untouched by water. Thus, the values proper to these surfaces were stored in a MS Excel file, for every wsp, where the following information were defined: the entire surface of wsp, the surface occupied by the drops, the number of drops and the surface of each drop, the percentage covering, the interval limits, frequency. (Boja F, 2009)
CONCLUSIONS

The studies and the research done for the machine model Stihl SR 420 conducted to the following important conclusions:

The usage field of activity of the machine SR 420 is much larger then that found in the specialized literature. If we take into account the constructive-functional features of the machine and the physical-mechanical characteristics of the materials which should be used for the plants we can say that the machine can be used successfully in many situations with practical and scientific importance.

The studies establish the fact that the usage of the machine becomes profitable to the maximum distance of 4 m.

Finally, the conclusions show that the used work method for the determination of the number of drops of the total surface of drops and for the covering percentage (the method based on the image analysis) is very accurate in most of the situations but it also has some flows as in the sample (WSP) 2-6-33 when based on the count algorithm a single drop resulted on the entire surface. To conclude with the phenomenon of „washing” the WSP appears here being an infinity of small drops which the count algorithm cannot established.

REFERENCES


Table 2

<table>
<thead>
<tr>
<th>Statistical indicators</th>
<th>Measure units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Size standard surface</td>
<td>628.97 mm²</td>
</tr>
<tr>
<td>Total number of drops</td>
<td>1671 buc</td>
</tr>
<tr>
<td>The total area of droplets</td>
<td>170,7649 mm²</td>
</tr>
<tr>
<td>Percentage coverage</td>
<td>27.15 %</td>
</tr>
<tr>
<td>Extreme values of surface drops</td>
<td>2,4857 mm²</td>
</tr>
<tr>
<td></td>
<td>0.0018 mm²</td>
</tr>
<tr>
<td>Amplitude of variation, w</td>
<td>2.483 mm²</td>
</tr>
<tr>
<td>Number of classes, k</td>
<td>25</td>
</tr>
<tr>
<td>Class sizes range</td>
<td>0.1000 mm²</td>
</tr>
<tr>
<td>Droplet surface class distribution</td>
<td>1315 149 70 22 24 18 16 9 5 5 5 5 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 1 2 3 4 5</td>
</tr>
</tbody>
</table>

Statistical indicators

Measure units

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