WATER DROPS STATISTICS BY IMAGE ANALYSIS

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Abstract

In this paper it is studied the possibility of using the watering devices used by man for pest control, with experimental composition in the laboratory for statistical assessing of some work optimal parameters as the following: the optimization of the liquid norms, the observation of the uniformity level, the number and the diameter of drops, the establishment of the efficient spraying distance for the performance of an optimal handling.

*Key words***:** *spraying devices, uniformity level, spraying, optimal handling.*

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 acquiring conveyable cost according to the other category of machines at the same destination.

The simultaneous obtaining of a maximum efficacy for pest control and for a minimum reduction of the pollution of the environment with pesticide substances are two contrary aspects of the measures for the chemical protection of crops. The treatments efficacy can be increased through the increase of the applied dose. This way of solving the problem has two shortcomings, because, on the one side the economical advantageousness of the applied protection method is reduced and on the other side, it is increased the risk of polluting the environment with toxic substances.

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.

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. (Stahli W. 2004). 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: Kiroritz, Fontan, Cifarelli, Solo and from a while the Stihl model. 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.

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

The searching program it was divided into two preoccupied direction which mention:

1. Studying the spraying machine Stihl SR 420 under the demonstration of the functioning to our thematically area, experimental verification and adaptable intervention of the machine for the optimal specific functioning.
2. Experimentation concerning the optimal norms of liquid, following the uniformity stage, number and the diameter of the drops, settle the necessary distance to realization of the optimal treatment. The experiment was divided into two phases such as:
   - The analyzed the drops distribution which goes on the working panel
   - The analyzed drops which fall on the ground on a distance of 1, 2, 3 an 4 meters.

For the doze regulation in the case of pneumatic spraying it can be used for guidance 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.

Due to the corresponding configuration of the sprayer, the formed drops cover a size spectrum of approximately 50 to 250µm (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 1).

Table1

Technical characteristics of the recommended sprayers.

Nr. Crt.	Technical data	Machine
		Stihl SR 420
1.	Thermic engine.	2 stroke
2.	Power.	2,5 kW
3.	Cylinder displacement.	44,9 cm^3
4.	Engine rotaries speed.	8000 rot/min
5.	Combustible.	Mixture of petrol/oil (1:50)
6.	Solution holding capacity.	14 l
7.	Air speed.	80 m/s
8.	Exhausted air volume.	18 m^3/min
9.	Horizontal action area.	12 m
10.	Vertical action area.	11 m
11.	Spreader material flow.	0,14 – 3,03 l/min
12.	Weight.	11 kg
13.	Combustible holding capacity.	1,5 l
14.	Air filter	Paper filter
15.	Flow degrees.	6

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.

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. (Figure 1).

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

Figure 1: Water sensitive paper (WSP) sample used at highlighting the drops cloud of active substance (number and size of drops).

The determination of the possibilities and of spreading uniformity was made through samples spraying, in the laboratory, were it was tried to highlight the storage way of sprayed liquid.

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 600×600 pixels per inch (1inch=25.4 (mm)), as in the example from Figure 3.

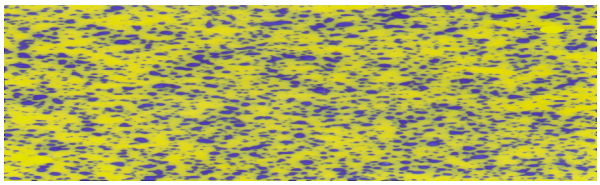

Figure 3. The digital image of a WSP with water drops (code 4-6-13.tiff).

Finally, it is determined spontaneous the number of drops (1671 for the taken example), their individual surfaces, the covering percentage (27,1499% for the taken example) and the bar chart of the drops surfaces from the WSP can be done (Figure 4); 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.

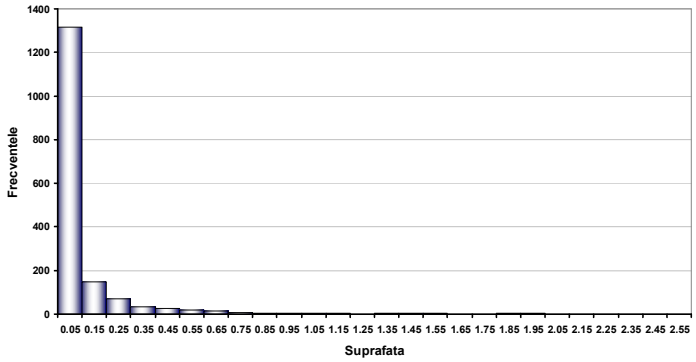

Figure 4. The bar chart of water drops surfaces from the WSP with code 4-6-13.

It is to mention the fact that the machine was at maximum rotative speed because the air speed determines the drops size.

As a consequence the flow relation:

$$q = A \cdot V$$

where: A is the section (here it is 5 m), V is the speed.

It results that the only variable parameter should be the speed because the section is not changing.

RESULTS AND DISCUSSIONS

All the data resulted after the processing were centralized in the charts below. So the following indicators were reckoned as it follows:

1. The number of classes was reckoned with the formula:

$$K = 1 + 10/3 \cdot \lg n$$

where: n is the total number of drops from a standard surface (WSP);

2. The variation amplitude was determined with the relation:

$$W = X_{\max} - X_{\min}$$

where: $X_{\max}$ is the drop with the biggest surface from a WSP, $X_{\min}$ = the drop with the smallest surface from a WSP;

3. The class interval was deducted with the formula

$$h = W/K$$

where: W is the variation amplitude, K is the number of classes.

The following statistical indicators were fixed in the centralizer: Arithmetical mean, Standard deviation, (s); the variation coefficient (s%) and the standard error of the arithmetical mean.

The variation coefficient was deducted with the formula:

$$s\% = (s/x)\cdot 100 .$$

The standard error of the arithmetical mean ($s_{\bar{x}}$) was calculated with the relation

$$s_{\bar{x}} = s/\sqrt{13} .$$

As a whole the following values were obtained values reported at a distance and at the flow grades of the machine (table 2).

Table 2

The distribution of the number of drops on the panel.

The Distance	Flow Grades					
	D1	D2	D3	D4	D5	D6
1m	10384	13358	16717	21154	18470	25282
2m	6022	13523	14093	12343	5881	11693
3m	3237	7080	19113	20677	16221	22342
4m	1550	7758	12308	13201	14433	12110

From the centralized obtained data it should be established a correlation between the total number of drops and the total surface occupied by the drops for every WSP, because it is not sufficient to be a huge number of drops but the total surface should be very small because the covering percentage is very low too.

From the assimilated experience, in the culture practice it is acknowledged that the chemical treatments contain the largest number of mechanized works from the works technology of producing the planting material.

The number of treatments applied the vegetation period is variable, depending on the nature of the used substance, infected degreed, the characteristics of the culture, the area and the climatic features of the region. The treatments done in time and in a corresponding way are one of the main conditions which contribute to the acquirement of large productions and of superior quality. Thus the light machines are preferred which permit the entrance in the ground even in the periods with high level of humidity in the soil, when the danger of pest control is bigger.

It also should be signaled the growing interest for using this models of machines at spreading biopreparation used for damaging pest control and the synthetic hormones used at the growing of some anatomical parts of forestry culture to the prejudice of others.

No matter the nature of usage, the machines from this category can be used in all season, allowing the material spreading in the form of powder and solution. It is important that the programmed technical works to be done in their optimal periods. As a consequence it can be understood that the

machines used for this reason should respond to many requests, some of then being already highlighted.

It could be added the fact that the machines should be known from the technical and economical point of view which allow fixing some usage limits. Firstly, it should be mentioned the fact that the drops size decreases with the distance.

Secondly, the number of drops which arrive on the panel at different debit degrees reach maximum values at a distance of 1-3 meters in this way: at 1 debit the number maximum is net at 1 m at 2 debit the maximum value is met at 2 m, at 3 debit at 3 m, at a debit at 1 m, at 5 debit at1 m and at 6 debit at 1 m.

From the first two sets of graphical representations we obtained some good values regarding the maximum number of drops which reach the work panel, reported to distance and debit degrees. So at the distance of 1 m the maximum values were obtained at the debits: D1, D2, D3, D4, D5, D6; at 2m the highest values obtained were at D2, D3; at 3 m D3, D6 and at 4 m the maximum value obtained at D5 debit degree.

Thirdly, at certain debit D1, the drops which fall on the panel to a certain percentage height but in the highest value they will decrease in the same time with the distance increase.

After we accomplished the graphics between the total number of drops and the total surface occupied by drops for each WSP the following conclusions can by said:

1. The total surface of drops does not vary according to the variation of number of drops depending on distance and debit.
2. The total surface of drops varies depending on the variation of size drops according to debit and distance.

During the exposition values can be resulted from the images because the variation mean of the surfaces is higher then the variation mean of the total number of drops.

The results were obtained to the samples from the soil, too, as it follows:

- If the debit is low, not many drops were created, if the debit increases, the number of drops increases too.
- The drops that reach the ground will increase in the same time with the distance increase (the most of drops to a bigger distance).

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 small drops which the count algorithm cannot established.

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