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INSPECTION OF PESTICIDES APPLICATION EQUIPMENT

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ABSTRACT
This paper shows the results of inspection of pesticide application equipment and support to applicators aimed to proper implementing and service of equipment. Improper or inadequate use of equipment can be hazardous or be unsafe by means of environment pollution. Paper will cover findings of nozzle wear influence, leakages on equipment and some of the major subjects surrounding exposure to pesticides during the application and to prevent contamination of food by common pesticides and its residual especially on crops.
Keywords: pesticides, application, equipment, nozzle wear, droplet size, savings

1. INTRODUCTION
Protection of crops (plant protection) has been mostly done by chemical means. Precise application of chemicals in agriculture is carried out using a sprayers and spreaders.
Large farms are almost entirely using of modern sprayers equipped with a wide grip for "integrated" chemical applications. The application of modern sprayers comes into play only with proper handling. Incorrect handling, poor application of pesticides or poor protection on the other hand does not come to the fore-quality products that are extremely expensive. The cause of the poor quality spray sprinklers is caused by malfunction in 40% of cases and caused by unprofessional handling of the 30% of cases. Other causes of applications were untimely and inadequate use of pesticides. And when it comes to malfunctioning, sprinklers are the most common cause, pressure gauges and pressure regulators. Risk of improper use of chemicals is in water pollution since many watersheds had been altered as a result of human being activities. These activities could led to pollution of rivers and degrade water quality [1]. Purification technologies depend on the origin and characteristics of wastewater and analysis of wastewater treatment efficiency should be performed [2].
Since 1995 FAO-AGSE has worked on the formulation of guidelines to improve the safety and efficiency of the most commonly used types of spray equipment. The FAO guidelines on standards are based on existing international, European and national standards and other published references.
The aim of this paper is to explain the reason and manner of selection and testing of equipment for the application of pesticides, which are the most important link between chemical agents and their biological effects.
Selection and proper use of equipment to apply pesticides is important parameter as the pesticides to be selected. Problems such as pesticides drift, irregular coverage, or failure targeting of the pesticides are due to the equipment. Most pesticides are applied with sprayers or spreaders. Sprayers are used with liquids or suspensions and spreaders with granula.

Nozzles as a key part of equipment control the amount of material to be applied, influence on formation of droplets and their size, as well as the droplets distribution. Pressure of the spraying system influence the rate of application.

2. CALIBRATION OF EQUIPMENT : DROPLET DIMENSION AND ADJUSTMENT OF THE PESTICIDE AMOUNT

The purpose of calibration is to ensure that equipment is applying the correct amount of pesticides uniformly over a given area. The flow should be about equal from each to each nozzle. If difference is over 5% from the average value, nozzle should be replaced.

Pesticides applied through foggers are used to treat insects in an air space however droplets will slowly sediment and deposit primarily on upper surfaces. Foggers are widely used in closed spaces like greenhouses, warehouses, grain stores and livestock buildings, as well as in some open situations, principally in plantation crops in still air conditions. Hot foggers generate fine aerosol droplets with a volume median diameter (VMD) of less than 25 µm, with oil-based formulations. Droplet size is usually slightly larger when water-based formulations are used. Cold foggers use an air shear or vortical (swirl) nozzle to shatter an ultra-low volume (ULV) spray formulation so that the VMD of the droplets is <50µm.

As a medium for the transmission of pesticide to the leaf surface of plants it is usually used water. Until recently, a large quantities of water for spraying (up to 2,000 l / ha of vineyards up to 1,500 l / ha in orchards) was used to protect the plant, it is thought that a plant needs to "swim" in a rescue agent. Recently, in intensively cultivated plantations leads to significant reduction in the amount of water used in plant protection. Many studies show that it is possible to significantly reduce costs, increase quality of care and use of active funds to 30%. Today is not rare that the plant protection uses only 200 to 300 l / ha of vineyards and about 150-250 l / ha of orchards. Such a method leads to the saving of working time from 40 to 50%, while overall costs are reduced by up to 30%.

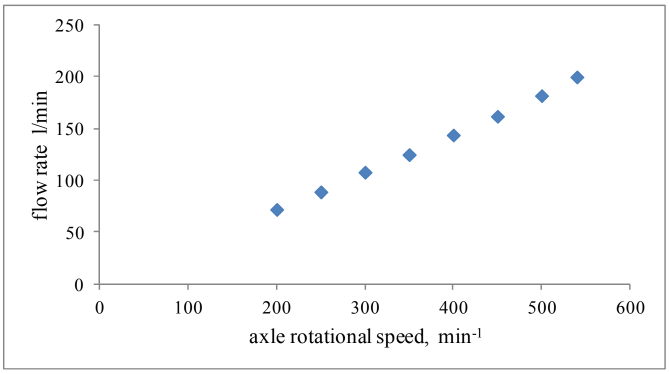

Figure 1. Dependence of pump capacity on revolution number of the pump axle [3]

Most research related to droplet is focused on:

- Shortening the length of floating drops to the plant,
- Reducing the number of droplets <100 µm,
- Improving the electrostatic adhesion voltage drops,
- Improving the quality of the air jet (quantity, capacity, direction, speed, etc.)

Arithmetic average diameter d_A is the diameter of the droplets, which are obtained by the sum of products of the number of droplets in the group and the average diameter of the group divided by the total number of measured droplets. The formula for its calculation is:

$$d_A = \frac{\sum_{i=1}^{k} n_i d_i}{\sum_{i=1}^{k} n_i} \quad \text{... (1)}$$

If there is n_i droplets in the group i (a total of k groups selected 1 .. i .. k), and the total number of droplets Σn_i (for i = 1 to k) = n, then the cumulative percentage (P_i) by volume , the i-th group equals:

$$P_i = \frac{\sum_{i=1}^{i} n_i d_i^3}{n_i d_i^3} 100 \quad \text{... (2)}$$

where: d_A = arithmetic average diameter of the jet (µm) ; d_i = average droplet diameter for a given group of droplets i (µm); k = upper limit that indicates the largest group of the measured droplet; n_i = number of drops in one group; i = number of droplet groups.

3. DISPOSAL OF DROPLETS ON PLANTS AND SURFACE COVERAGE

Regardless of the speed of air flow on the front leaf of most of the deposited droplets > 150 microns. On the last side of the leaf, where you only accept drops of less than 150 µm, the impact velocity is very important. The degree of surface coverage increases with increasing air flow velocity, which is only possible to explain the increase turbulent. When using large droplets, it is possible to achieve better performance, especially if you ignore the flowing and the runoff, but he is still focused on the front side of the leaf.

The average volume surface diameter of droplets allows calculating the theoretical size of the area covered by droplets. It is significant because it shows the degree of coverage of the surface to be sprayed over the given volume of liquid. His attitude toward the Middle volume diameter depends on the width of the spectrum in the jet drops. When liquid spray nozzles with flattened fan jet is usually about 85% of the middle diameter by volume.

3.1. Relocation of droplets out of the plantation – drift

In all the chemical processes occurring in plant protection fluid loss appears. The loss of fluids and its deposition on the soil may be due to larger diameter droplets, which, due to their mass, fall with the leaves. The loss drops of smaller diameter <100 µm can arise from the removal of these plantations.

Removal of tiny droplets of crops is a problem that today's science, in collaboration with designers, trying to reduce. The present findings suggest seeking the most favorable interactions of climatic conditions, narrowing of the droplet spectrum, machinery design modifications and adjustment of the shape of plantations.

3.2. Effect of air velocity on the surface coverage

The limit of conventional spray sprinklers with a wind speed of 4 m/s. With air support using the "Twin" system, small droplets are carried by air current speed and transported to the plant. The losses are reduced, and simultaneously achieve a better distribution of preservative per plant. Reducing losses by air support is so that even at wind speeds of 8 m / s plant can be successfully sprayed. Air flow supports allow to chemicals to penetrate more in depth, which is a significant advantage in a culture that is densely planted and have a dense habit.

If sprinklers are used with air support, it is significantly lower consumption of water, up to 50%. These savings are worth the crops that are in the beginning of growth, regardless of the type of jets, ie, droplet size. When spraying plants in the later stages of development increases and cost savings of up to to 80%. Practice has shown that water consumption ranges from about 150 l / ha, which also means that time is much shorter refueling.

If using the "Twin" system, small droplets are created by the smaller quantity of water have a much greater biological effect than large droplets, as small droplets covering over the treated area.

4. EFFECT OF NOZZLE WEAR ON THE EFFECTIVENESS OF APPLICATIONS

The most common materials for making nozzles are stainless steel, stainless steel, ceramic, plastic, brass and bronze. Ceramic and stainless steel, are more resistant to abrasion, but also more expensive. Brass as a material for making that so far the most used is gradually being replaced with polymers. In tables 1 and 2 are shown parameters of nozzle wear.

Table 1. Factors of wear for certain materials used in the production of nozzles
(1 - the fastest-wear, 200 - the slowest wear)

Material	Wear parameter
Messing	1
Stainless steel	4-6
Hard Steel	10-15
Ceramics	90-200

5. TESTING OF EQUIPMENT FOR PESTICIDE APPLICATION

Testing equipment for the application is carried out to determine the amount of the pesticides and its distribution solutions, while the flow of each nozzle is observed separately.

Such tests are carried out within the manufacturer's factory (Figure 2 and 3), and before the season using sprinklers mandatory testing should be performed, because the correctness and accuracy of one of the fundamental factors in the implementation of practices and agricultural production in general.

Figure 2. Mobile device for measuring the flow volume [4]

Figure 3. Cylinders used to measure the amount of flow in a nozzle

Operator has to be sure and to check all the mechanical parts for wear and to avoid troubleshoots of any faults. Most important parameters in the production of equipment is the uniformity of the nozzle, they must be cleaned and examined. Sprayers to be adjusted to the desired working pressure us in a certain unit of time (15, 30 or 60 seconds) to carry out testing nozzles capturing droplets in front of these containers, and to compare the results of all tested nozzles. In the event that the difference of water per nozzle is greater than 10%, nozzles should be replaced. Nozzles are supplies, subject to abrasion and wear, therefore, testing should be done always before the intensive use of sprinklers.

Because of this and the necessary importance of safety pressure regulators, because a change of peace and change the speed of shaft revolution speed, which ultimately affects the change of pressure, and then using the same operating pressure regulator adjustments.

6. CONCLUSION

In the modern intensive agricultural production increasingly takes measures for environmental protection. Examples from the EU show us how intense development and production undermine harmony with nature and have begun to introduce measures and specific laws that the same would not have taken place. New laws in the Republic of Croatia and the EU, it would affect the technical systems to protect their crops and mandatory testing to pesticide application was justified and correct.

One of the important factors of pesticide applications is their drift. Losses in this way amounts to 30% of all losses and applications they need to add more attention. If it is determined drift droplets increase the cash losses, but mainly negative impact on the environment. Pesticide droplets of smaller diameter can be taken away to far more open waterways, residential areas, other cultures and thus affect the health of humans and animals. One of the major factors affecting the drift droplets are the weather conditions over the parameters of wind and temperature. To avoid this person who made the choice must spray nozzle, operating pressure, spray height specify the size of the droplets to avoid drift.

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