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ASSESSMENT OF THE IMPACT OF THE AIR STREAM GENERATED BY THE MOVEMENT OF THE DRONE'S PROPELLERS ON THE VERTICAL DEPOSITION OF THE SPRAYED LIQUID

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SUMMARY

An attempt was made to assess the impact of the air stream generated by the movement of the drone's propellers on the vertical deposition of the sprayed liquid on samplers placed on a frame constituting a model of a dwarf fruit tree.

Keywords: spraying, drone, liquid deposition

INTRODUCTION

Research on the techniques of precise pesticide application treatments in orchards with the use of unmanned aerial platforms are under development. The main direction of research is to optimize the operating parameters of flying platform to spraying in order to obtain uniform application of agent in the dosage required and to reduce the drift of droplets and reduce the consumption of chemicals. Multirotor drones, hovering above plants, generate a downward flow of air, which is the effect of generating the thrust needed to lift and move at the required speed at a certain ceiling [1,3]. In traditional orchard sprayers, it is possible to adjust the parameters of the air stream, its direction and the intensity of the outflow [2]. In the case of drones, the intensity and direction of the air stream depend on the thrust necessary to keep the platform in flight. Thrust is a function of the average velocity of the air stream "pumped" by the drone's rotors and the surface and shape of the propellers. The rotational speed of the drone's rotors is primarily determined by the total weight of the device, which changes as the working liquid tank empties [1]. The effect of the air stream may have a positive effect on the vertical deposition of the spray agent, especially in the lower parts of trees [4,5,6].

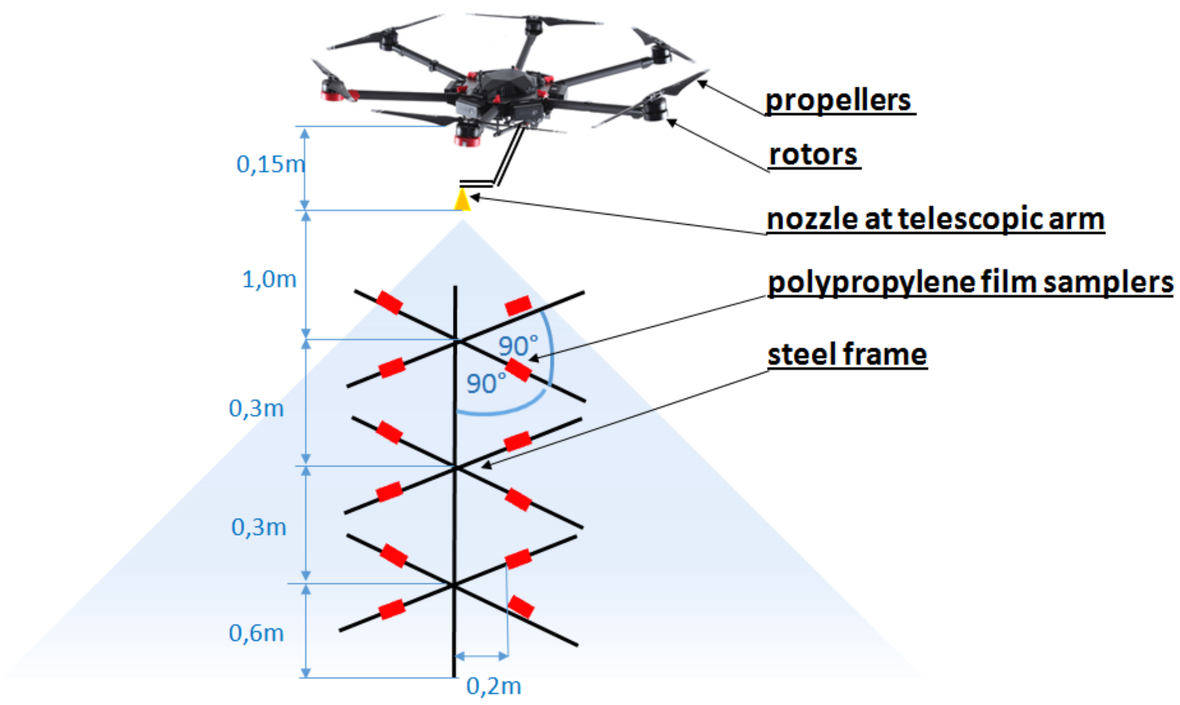

Fig. 1. Visualization of the test stand *[own work]*

METHODS

A rotor drone was used for the research - a hexacopter. The drone with a liquid spraying system was mounted on the frame. A nozzle was mounted under one of the drone's rotors, to the longitudinal adjustable frame. Centrally under the nozzle, there were stands made of metal rods arranged crosswise, on which was placed the probes at three heights take into account the dimensions of two-year-old fruit trees (cherries) on a dwarf rootstock. The drone was moving along the line of tripods imitating trees with a speed of 1 m x s^{-1}. The value of the working pressure of the sprayed liquid was constant and amounted to 2 bar, and the rotational speed of the drone's rotors at each test was 6000 rpm, which corresponded to the thrust needed to lift the drone with a complete instance and a full liquid tank [1]. As a control, the liquid was sprayed with the drone's engines turned off (without a blast of air from the propellers).

The liquid used in the research was distilled water, stained with aqueous nigrosine, with a dye concentration of 0,5%. The liquid concentration in individual samples was assessed by means of spectrophotometric analysis. The dye concentration determined by a photocolorimeter was adopted for further analysis as a measure of the volume of liquid deposited on the samplers.

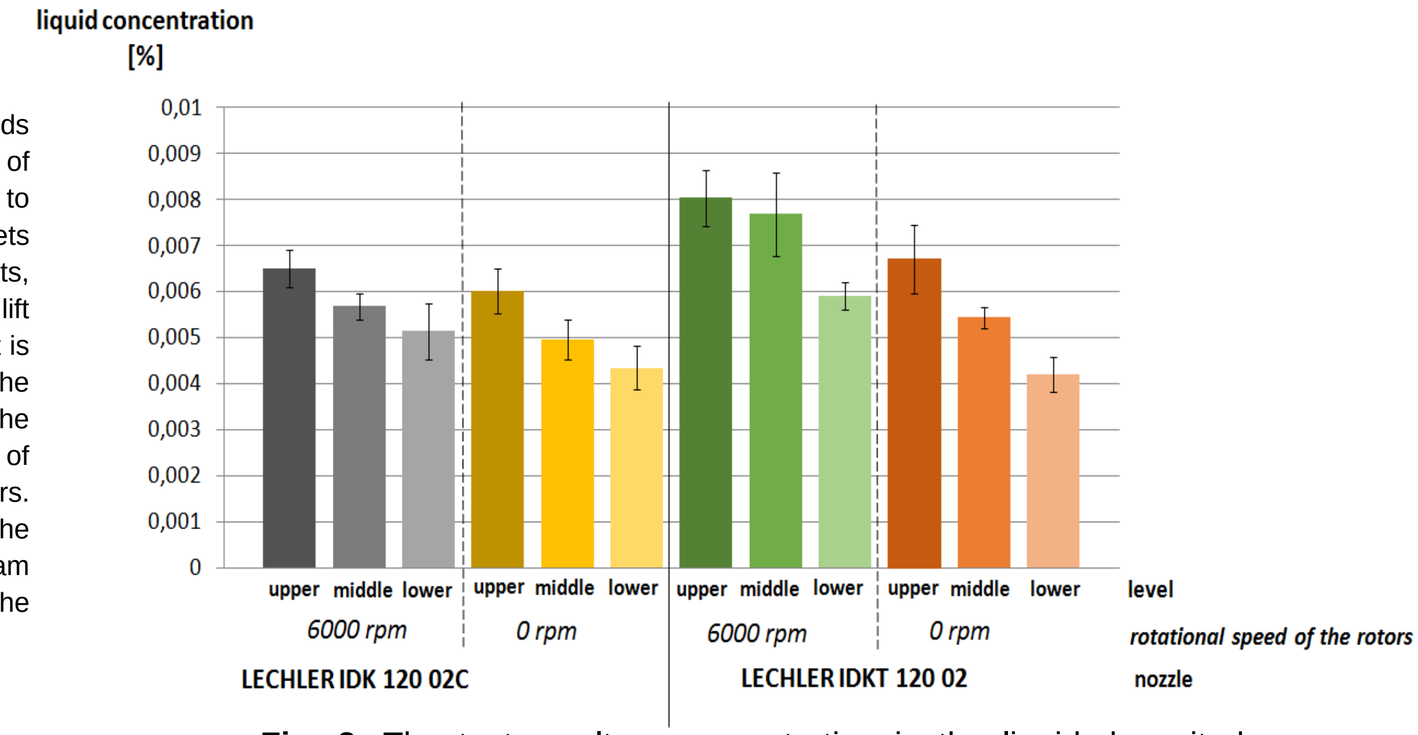

Fig. 2. The test results - concentration in the liquid deposited at the various levels *[own work]*

CONCLUSION

The obtained test results indicated that during spraying the most liquid was deposited at the upper levels. Regardless of the type of nozzle and the impact of the air stream caused by the movement of the propellers, the least sprayed liquid was deposited on the lower levels. The analysis of the results showed that the air stream had a significant effect on increasing the volume of deposited liquid at each level. The type of nozzle was also important. Spraying with the use of the Lechler IDKT 120-02 double-stream ejector nozzle resulted in a significantly larger volume of deposited liquid than in the case of the IDK 120-02C flat-stream ejector nozzle, although the same flow rate of liquid.

Similar results were obtained by Tang and Zhang and co-researchers in their experiments conducted in 2016-2018 on citrus trees. They also observed variation in leaf coverage in the different layers of the canopy. Also in their experiments, the highest liquid deposition was observed in the upper parts of the canopy. They also stayed that the airflow caused by the rotating propellers of the drone had a positive effect on liquid penetration into the tree, not only directing the spray droplets, but also parting branches and leaves and increasing liquid access to the inside of the canopy [4,5,6].

LITERATURE

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