Section 1

Influence of the tractor driving speed on the sprayer air flow

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The deflection of air flow of an orchard sprayer due to the driving speed of the tractor influences the spray application in the orchard. In order to get a sufficient protection of the trees avoiding unnecessary drift losses to the air and the soil the whole process has to be optimized. In addition the noise annoyance and the fuel consumption will become more important. As the flow field and the droplet transport is complex experimental investigations are indispensable.

The paper describes the activities and results achieved in the research work carried out in a co-operation of the Graz University of Technology (TUG) as well as by the Association of Styrian fruit growers (VStE). The main objective of this research was to investigate the influence of the driving motion to the spray application in the orchard. In addition, this effect should be included into the existing rating of orchard sprayers.

So far, the influence of the driving speed has been hardly taken into account in the spread of the air stream in the orchard. This was less important due to low tractor speeds and lower tree heights. Nevertheless, this important effect for droplet transport at high speeds (up to 12 km / h) in combination with trees up to 5m high has been investigated in this research project. Based on the results, a practical guide for the user of the sprayer has been developed, in order to arrive at a resource-conserving crop protection.

With the purchase and installation of a new air test rig, the most important prerequisite for the experimental detection of the wind influence has been created. Following an intensive phase of comparing air measurements in two round robin tests with the South Tyrol Consulting Agency (I), the market community Bodenseeobst (D), the adjustment work on the hardware and software was carried out. Simultaneously with the stationary measurements the preparation work for air measurement in drive was done. A correspondingly large hall was available at a fruit store company for the measurements in motion. In a three-day measurement campaign an extensive program was successfully carried out with four different sprayer types from several manufacturers. The analysis shows that the relationship between stationary measurement and measurement in drive is device dependent and therefore a simple conversion factor cannot be applied.

Another important aspect of the project was to investigate the "optimal" sprayer-settings for the spraying in the orchard. Two measurement campaigns were carried out in an orchard in leafless and full leafy state. They were carried out as realistically as possible with spray at appropriate meteorological conditions for different driving speeds. In order to provide a resource saving spraying the following main influencing parameters have been found: fan type , power take of shaft(PTO-) speed and thus blade speed, driving speed, distance between the rows of trees and height of the trees. Different sprayer types applying different concepts are available on the market. They differ in the fan type (radial or axial) , the deflection of the air stream up to the cross section of the spray nozzles, and in the form of the air flow after exiting from the blower (for example a larger width at lower speeds or narrow at higher speeds, different direction of flow with droplets). It will also generate the above-mentioned different deflection behaviour of the airflow of individual sprayers in driving. By the use of a statistical analysis a uniform interpretation of the measurements has been done, so that a conclusive link between stationary measurement at the air test rig and the behaviour in the orchard does exist. It is now possible, when specifying the above mentioned boundary conditions (blower type , spacing of rows of trees and height of the trees), to provide an optimum PTO-speed for a given driving speed. This information for the adaptation to actual conditions during the spraying process can be provided to the farmers through a special software. This gives the farmer the corresponding PTO-speed for the currently

used sprayer for a selected fruit culture for a given tractor speed. In addition, x-comply provides the complex administration and documentation of the spraying.

Based on these results a test method was developed on the basis of stationary air measurements, so that the sprayers can be developed by the manufacturers. In addition, all the individual sprayers can be checked with the testing procedure at independent testing centres. Precondition that this onetime-measurement is sufficient for the entire useful life of the sprayer is that the air-carrying parts cannot be altered anymore. Using the data from the stationary measurement provides all the information for the settings for the spraying. So the prerequisites for an economical and environmentally friendly application of pesticides in fruit crops are now given at maintaining full effectiveness.