

Results of Measuring the Air Distribution of Sprayers for 3D-Crops and Parameters for Evaluating and Comparing Fan Types

P. Triloff

Marktgemeinschaft Bodenseeobst eG, Friedrichshafen, GERMANY

Introduction

The realisation of an efficient crop protection in three dimensional crops with respect to work rate, avoidance of visible deposits on the fruit, minimized risk for phytotoxicity, minimized number of fillings per spray trip, minimized pesticide consumption and minimized costs, requires low volume spray application with small droplets. To keep their high potential for spray drift low and reduce spray drift to levels obtained with air induction nozzles, officially registered combinations of techniques and methods for drift reduction are available in Germany and Austria since a number of years. Basic requirement for drift reduction from small droplets is a fan with cross flow characteristics and rectangular air distribution over working height. The former reduces long distance vertical spray drift while the latter allows adaptation of the horizontal reach of the air stream by forward speed and fan speed to canopy width, so that almost no more spray mist spews from the canopy into the next alley way, resulting in a maximized deposition at the target and a reduction of short distance horizontal spray drift.

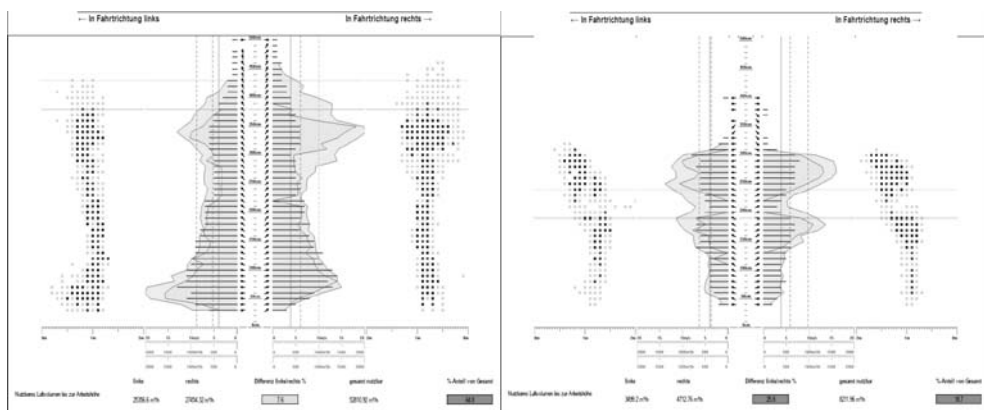


Figure 1: Unusable vertical air distribution patterns of fans with cross flow characteristics from orchard sprayers for canopy adapted spray application

Besides the reduction of spray drift, a canopy adapted air stream remarkably improves the efficacy of pesticide deposition, allowing canopy adapted dosing and canopy adapted spray application at high forward speeds of up to 12 km h⁻¹ in slim canopy structures which increases work rate once more and reduces fuel consumption and noise emissions enormously. The adaptation of fan speed to canopy width therefore offers a whole range of important benefits to the fruit and wine grower, explaining the increasing interest in this technique.

A major obstacle of applying this technique at the grower level is an uneven horizontal reach of the air stream of most fan types produced for three dimensional crops (**figure 1**), because in the past only fan power has been of interest since it was and still is a wide spread misbelief that successful crop protection requires high air flow rates. Unfortunately the operation of a fan with an uneven air distribution at a combination of fan speed and forward speed where the horizontal reach of the air stream at one or more specific sections of the fan is too low to properly penetrate the canopy at the corresponding positions, causes infestation from pests and diseases. Without having the chance to measure and correct this defective distribution, the only chance for avoiding spray application related infestation is an increase of fan speed and/or a reduction of forward

speed to increase the horizontal reach at the section where it has been too low. All three cases result in a reduced quality of the spray cover and increased spray drift, but also raise fuel consumption and noise emission; if forward speed has been reduced in addition to an increase of fan speed, also time consumption is increased. In any case costs for crop protection are rising because of a poor air distribution. Excessive fan speed and a necessity to reduce forward speed because of a poor air distribution also increase the risk of complaints from bystanders and settlement areas next to orchards and vineyards, potentially leading to serious public conflicts. Therefore the adaptation of the spray application to canopy characteristics by adapting fan speed and forward speed to canopy width is considered absolutely essential for a highly efficient application of pesticides and the minimization of a range of negative side effects in three dimensional crops.

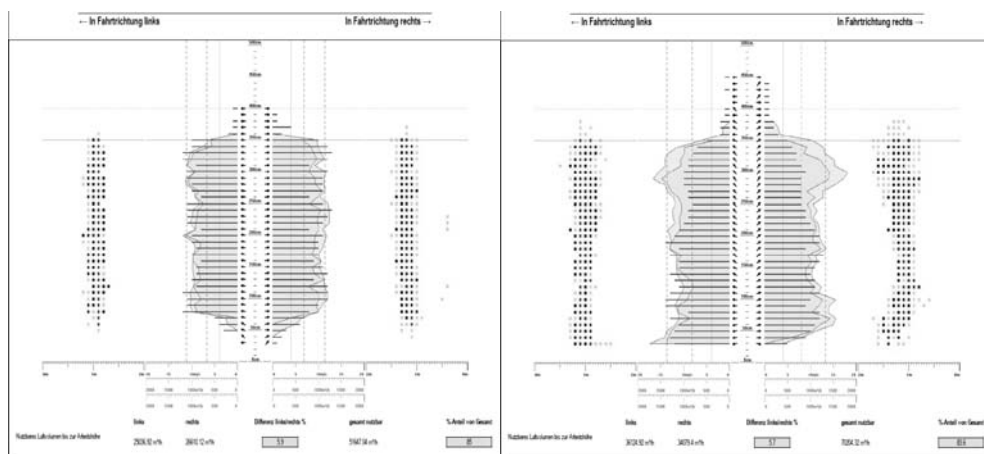


Figure 2: Almost perfect vertical air distribution patterns from orchard sprayers adjusted to a working height of 3.5 m

Material and Methods

To measure the air distribution of a fan, but also to individually adjust working height to the tallest structures that are going to be treated at the buyer’s farm and to straighten the horizontal reach of the air stream over farm specific working height to obtain a rectangular distribution, test benches are required. Improving the air distribution of fan types in general requires a close cooperation with sprayer manufacturers since many fan types require extensive constructive modifications to improve the vertical air distribution. At the begin of a fan type testing procedure the maximum working height is identified after which the horizontal reach of the usable air volume is straightened within this working height in order to obtain a rectangular air distribution. After the fan has passed the air distribution test at 460 PTO speed and high fan gear (**figure 2**), it is tested again at 540 PTO high gear and 300 PTO low gear to gain data about the changes in usable and non usable air volume and working height as fan speed varies. In a next step energy consumption and noise emission are measured at the PTO shaft at all three fan speed settings to obtain “environmental data”, important for the calculation of energy consumption, CO₂-footprint, several efficiencies, and noise emission, allowing the direct comparison of fan types from various brands.

From energy consumption, amount of usable air volume and maximum working height at defined settings of the fans, first universal parameters for the comparison of all kinds of fans have been developed, as there are the “usable air volume per hour and meter of maximum working height”

describing the strength of the fan and the “*specific fuel consumption per m³ of usable air and hour*”, describing the energy efficiency of the fan, but also total fuel consumption including the tractor to give the growers an idea about total Diesel consumption per hour.

This comparison is important for advisors and growers to select the most suitable fan type for the farm specific situations concerning working height, required usable air volume, fuel consumption, noise emission and other parameters. The protocol delivered with the new sprayer proves that the sprayer reaches the desired working height and provides a rectangular air distribution pattern at both fan sides, enabling the buyer to adapt fan speed to any canopy width on the farm without the risk of producing stripes of infestation from pests and diseases at minimized spray drift, fuel consumption and noise emission.