Evening program

Low-loss spraying

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DOI 10.5073/jka.2012.439.017

Summary
"Low-loss spraying" is a new application technique which has been developed by the Association of Styrian Commercial Fruit Growers (Austria), the Marktgemeinschaft Bodenseeobst (Germany) and the South Tyrolean Extension Service for Fruit- and Winegrowing (Italy) and is being put into practice at present.
These three fruit-growing regions, which use for the most part the same sprayer types, are faced with new challenges: larger areas per sprayer with higher trees, also in intensive orchards, than in the past (up to 4 m), stricter standards regarding drift reduction, power consumption and noise.
The pivotal element of this new application technique is an optimized and controlled air blast. The direction and intensity of the air stream are important factors for the coverage and the losses caused by spray drift. Therefore, the professional school for fruit-growing at Gleisdorf (Austria) constructed an air-flow test bench, which served as a model for three new test stands, which were bought by the Marktgemeinschaft Bodenseeobst, the South Tyrolean Extension Service and the manufacturer of spraying equipment Lochmann.
In addition to the usual legal requirements, "low-loss" sprayers have to be equipped with a fan producing an appropriate vertical distribution of the air, drift-reducing flat jet injector nozzles at the top and hollow-cone nozzles below them as well as standardized test ports for the pump and pressure gauge. It is indispensable for the grower to have access to appropriate training and counselling in order to be able to adjust his sprayer in an optimal way to the shape of his trees with regard to air flow, water and pesticide amount, pressure, forward speed and rotation speed of the PTO.

Introduction
The application of pesticides in bush and tree crops, such as in fruit- and winegrowing, usually causes more drift than in arable farming. Whereas in the past the focus was mainly on the biological effect, now and even more in the future the aspect of drifting has to be taken into consideration.
One way of reducing drift and improving the biological efficacy of a pesticide is "low-loss spraying".

Legal requirements regarding drift
The South Tyrolean fruit- and winegrowers have to comply with several legal requirements regarding drift:

- The EU-Directive on the sustainable use of pesticides;
- the provincial guidelines on the distances to be kept when treating orchards bordering on residential or public buildings as well as roads and other properties which are not agriculturally used;
- the use instructions on the labels regarding the distances to waterways.

A sensitive topic is the application of pesticides next to villages and tourist areas. Concerned citizens turn to the local authorities and the media, which do not always deal with this topic in a rational way and often stoke people's fears. "Low-loss spraying" diminishes the drift and the visible spray plume considerably. This application technique requires a cross-flow fan, air induction nozzles, optimum air distribution and an amount of air adjusted to the tree height in the respective orchard.

Taller trees – not easy to achieve good coverage
For the past fifteen years the apple trees in South Tyrol have not been trained any more as a 2 – 2.5m high "slender spindle" according to the Dutch model but as a "tall slender spindle". Geometrically, the

shape of the "tall slender spindle" resembles more or less a column. Thus, it has become more difficult to achieve good coverage in the 3.5 – 4m high tree tops. As can be seen from the inspection protocol, when using sprayers without cross-flow fans too much liquid is applied to the lower part of the tree and too little to the top section.

"Low loss spraying"- 4 key factors

"Low loss spraying" is a joint project of the Styrian Commercial Apple Growers (Austria), the Marktgemeinschaft Bodensee (Germany) and the South Tyrolean Extension Service for Fruit- and Winegrowing (Italy). Common guidelines have been drawn up and can be seen on the homepage www.obstbau.at.

Key factor 1 – Even air distribution

The first important condition for "low-loss spraying" is a uniform air-distribution from top to bottom of the target trees. This can be measured and, if necessary, optimized at an air testing facility which checks air speed, the amount of air and the direction of the air flow.

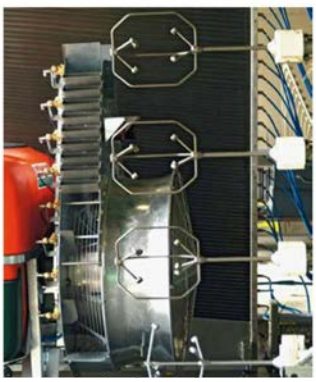


Fig. 1. Device for air flow measurements.

Fig. 2. Air flow test protocol.

At the air testing facility the amount of air ejected is measured up to a height of 5m. It is divided into 4 areas and represented in a quadrant comparison chart. The amount of air on the left is compared with that on the right, and the amount in the lower half is compared with that in the upper half. If the difference does not exceed 10%, a green box appears in the test protocol.
The two red boxes indicate that the air amount in the bottom half is on both sides higher by 21%, respectively 26% than in the upper half. Since the nozzles in the upper half transport the droplets to the top of the trees, the air blast is too strong for the lower part and too weak for the upper part of the trees. After calibrating the sprayer and mounting air deflector plates an even distribution over the whole height of the target trees was achieved.
At the air testing facility air speed and direction are also measured and shown in the form of a diagram. The air speed is measured at 10cm-intervals and depicted as a vertical bar. The longer the bar, the higher is the speed. The test protocol on the left shows that air velocity is too high up to 1.5m from the ground. The two vertical lines mark a minimum speed of 3m/second. We assume that this minimum velocity has to be reached at the test stand in order to be certain that sufficient liquid is deposited on the trees in the orchards. The tested sprayer reached this speed up to a height of 3.5m. Before the adjustment the air speed was therefore too high in the lower part and sufficient up to only 3.5m. By installing and adjusting air deflector plates a more uniform air distribution up to 4m was achieved.

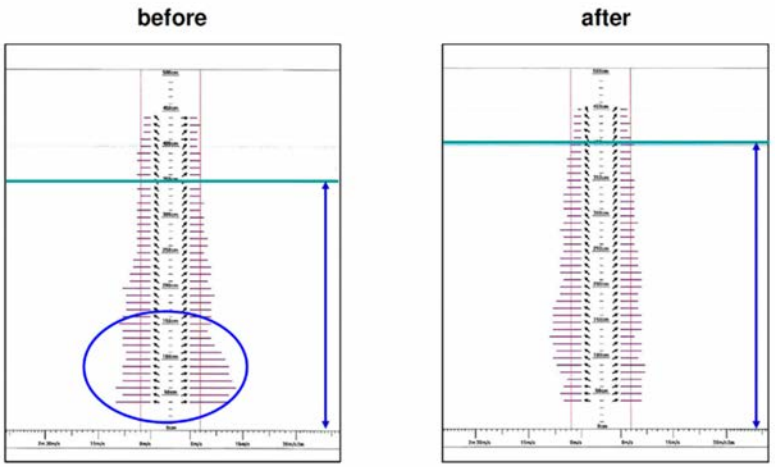


Fig. 3. Air speed diagram.

Key factor 2 – Use of different nozzle types

"Low-loss spraying" also requires a mixed set of nozzles. On the lower part hollow-cone nozzles are mounted, the last three nozzles at the top are air induction nozzles.
In our orchards and vineyards drifting and spray plumes are caused primarily by the uppermost nozzles. In both pictures the right hand side of the sprayer is fitted with hollow-cone nozzles and air induction nozzles, the left hand side only with hollow-cone nozzles. Thermal drifting occurs on sunny days with updraughts. The smallest and therefore lightest droplets rise and can travel as far as 100m.
By mixing nozzle types we are trying to balance the advantages and disadvantages of both hollow-cone and air induction nozzles.
The lower part of the tree is sprayed with hollow-cone nozzles. Since they produce smaller droplets, the coverage rate is better and losses due to runoff are lower than with air induction nozzles, which eject larger droplets. Due to an improved air flow drifting is negligible in the lower part of the tree.

The upper part of the trees, on the other hand, is sprayed with air induction nozzles. The disadvantage of a poorer coverage rate is balanced by a sufficiently strong air blast towards the upper area of the canopy. The larger droplets emitted by air induction nozzles are carried less far and fall on the canopy or the orchard floor. Furthermore, in this way a conspicuous spray plume which can be seen

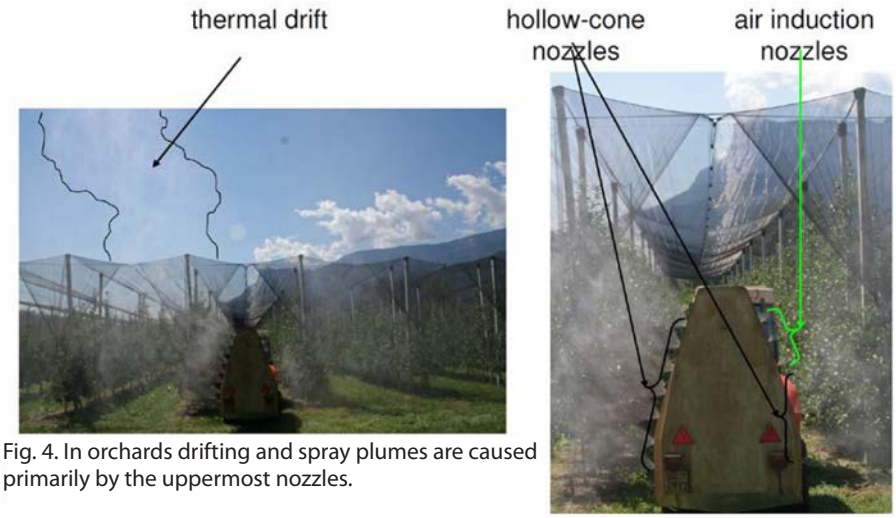
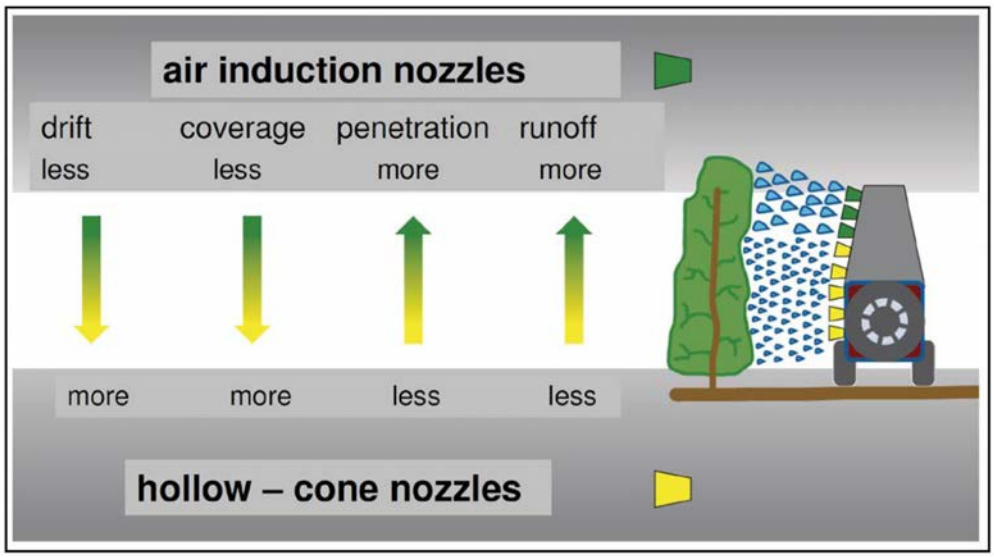


Fig. 4. In orchards drifting and spray plumes are caused primarily by the uppermost nozzles.



from afar can be avoided.
Fig. 5. Pros and cons of different nozzle types.

Key factor 3 – Good filter system

Since air induction nozzles are prone to blockage, a good filter system is indispensable for ensuring that they will work smoothly.

Key factor 4 – Adaptation to the individual orchards

The fourth condition for "low-loss spraying" is determining the exact quantity of pesticide and liquid necessary as well as the air pressure and driving speed required for an efficient treatment of the individual orchards.

The South Tyrolean Extension Service offers assistance to each of its members in working out a chart listing the exact liquid amount per hectare as well as the necessary pressure and driving speed. The Marktgemeinschaft Bodensee and the Association of the Styrian Commercial Fruit Growers calculate

this using the "Mabo Dosage Model".
Fig. 6. Adaptation of the air blast to the individual orchards.

Even a tested and optimally calibrated sprayer can serve its purpose only if it is correctly used by the grower. Therefore, the sprayer has to be adjusted to the individual orchards after the air flow tests. The spray plume has to be optically assessed by a second person while the sprayer is being driven through the orchard. Only in this way is it possible to ideally synchronize the driving and rotation speed needed to ensure that the droplets reach the tree top while at the same time penetrating the canopy only gently. No visible spray mist should reach the neighbouring tree rows.
In order to be calibrated at the testing facility, the sprayer has to be equipped with connections for the manometer and the pump test.

Conclusions

The "low-loss spraying" effort shall enable the grower to buy a sprayer ideally adjusted to the height of his trees, allowing him to apply a pesticide in such a way that it gently penetrates the canopy without drifting into the next alley or in the air above the tree tops. With the "low-loss" sprayers in use at present power consumption and the noise of the fan have been reduced on average by half, as demonstrated by measurements performed by the Bundesanstalt für Landtechnik Wieselburg (Austria).
The manufacturers of "low-loss" sprayers are therefore challenged to construct fans with uniform air distribution up to the necessary tree height and an exact limitation there.
If the sprayer meets all the requirements for "low-loss spraying", an inspection label is attached to it. You will find further information about this application technique on www.obstbau.at.