

Experiences with and benefits of the inspection of air-assisted sprayers from the fruit- and winegrowers' point of view

Waldner, W.; Knoll, M.

South Tyrolean Extension Service for Fruit- and Winegrowing, A. Hofer-Straße 9/1, 39011 Lana, Italy
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Summary

Until the 1960s pesticides were applied with a spray gun connected to a long hose or directly to the tank and operated by a worker standing on a platform. This technique was gradually replaced by air-assisted sprayers.

The purchase of three sprayer test facilities in 1991 signified the start of a new era in pesticide application:

- The ejection rate of the individual nozzles as well as the distribution pattern of the liquid could be measured and optimized on a vertical test stand by adjusting the nozzles or adding additional ones.
- The ceramic nozzles were replaced by hollow-cone nozzles, which allowed for the first time to calculate the exact amount of liquid per hectare and tree height based on various parameters such as driving speed, spray pressure, number of open nozzles and nozzle output volume. The amount of water was reduced from 500 l/m tree height and hectare to 166 – 100 l.
- The efficacy of the pesticides was increased and spray drift reduced, which brings about economic and ecological benefits.
- Up to the year 1997 sprayer calibration was optional. Since then, a sprayer calibration in 5-year intervals has become a condition for participation in the South Tyrolean IP-programme. This also facilitates the observance of the GlobalGAP control points and Compliance Criteria regarding application equipment.

Since 2011 the South Tyrolean sprayer manufacturers and fruit- and winegrowers have been able to measure and optimize the air blast and emission pattern. Thereby we hope to further reduce spray drift and increase the efficacy of the pesticides. A properly calibrated sprayer enables the fruit- and winegrowers to observe more easily the regulations for the distances to residential and public buildings as well as pastures enacted by the South Tyrolean Provincial Government and AGRIOS in 2011. We trust that the South Tyrolean fruit- and winegrowers will have no difficulties in complying with the Directive 2009/128/EC on the sustainable use of pesticides with regard to application techniques and sprayer calibration.

Introduction

South Tyrol is the northernmost province of Italy and together with the province of Trentino it forms the autonomous region of Trentino – Alto Adige. 80% of the Italian apples come from this region. The apple growers from Trentino supply their marketing operations with almost 600,000 tons, the South Tyrolean growers have produced over 1 million tons annually over the past four years, which makes up more than half of the Italian and over 10% of the total European production. The South Tyrolean apple orchard area amounts to 18,500 ha altogether, which are split up among approximately 6,000 operations and about 10,000 owners.

The South Tyrolean vineyard acreage accounts with approximately 5,300 ha for less than 1% of the total Italian acreage. The annual wine production ranges from 300,000 – 400,000 hl, which makes up only 0.6% of the total annual production in Italy. The South Tyrolean vineyard acreage is divided among about 5,000 operations. Without the aid of strong cooperatives and growers' associations the small South Tyrolean fruit and wine producers would not be able to hold their ground in the modern global markets. Approximately 90% of the apples and 70% of the wine are marketed by cooperatives. South Tyrol is situated on the south side of the Alps. 64% of the cultivated area is located on elevations higher than 1,500m above sea level. The major part of the agriculturally used area is made up of alpine meadows and pasture land. Only 8.5% of the cultivated area is lower than 800m above sea level and it is mostly used for growing apples and wine grapes.

The South Tyrolean fruit- and winegrowing operations are usually very small. Family operations with about 2.5 – 3ha predominate. Traditionally, each of the approximately 6,000 fruit and wine operations has its own machinery stock consisting of one or two tractors, one or two trailers, a mulching machine, an elevating work platform and a sprayer.

Approximately 2/3 of the winegrowing area are situated on the valley floor, 1/3 is on the hillside. In addition, the orchards of these 2.5 – 3ha small operations are usually dispersed across several locations. Therefore, the sprayers have to be roadworthy and suitable for flat and sloping plots at the same time. Since most operations produce both apples and grapes, the sprayers are used in orchards as well as in vineyards. This has to be taken into consideration when calibrating the sprayers at the testing facilities.

Spring frosts are quite frequent on the valley floor, therefore all orchards are equipped with overhead sprinklers, which are used for frost protection and irrigation.

Nearly half of the orchards are provided with hail nets.

Due to the overhead irrigation and the hail nets the use of tunnel sprayers is impossible in South Tyrol, therefore almost exclusively axial fan sprayers with or without cross-flow fan attachments are in circulation here. The majority of these sprayers are produced by four local sprayer manufacturers.

In the South Tyrolean orchards single rows are the predominant planting system. The average orchard alley is 3 – 3.2m wide and the trees are 3.5 – 4m high.

On slopes the trees are often planted in bed systems, which means that the orchard alleys are sometimes spaced up to 12m apart. Some operations have to use the same sprayer in both single row and bed plantings. This has also to be considered when calibrating the sprayers. Axial fan sprayers with a cross-flow fan attachment are preferred. The sprayer test and adjustment at the vertical test stand serve to achieve a uniform distribution of the spray liquid up to a height of 4m.

In viticulture the oldest and still predominant training system here is the “pergola”. 70% of the vineyards are situated on slopes or in hilly areas. The sprayers used in these locations cannot be adjusted at the vertical test stand. In this case we can only check the liquid amount ejected by the nozzles and calculate the pesticide quantity required per metre grapevine canopy height and per hectare, so that neither too much nor too little pesticide is applied. In new vineyards wire trellis systems are preferred, because they are suitable for cross-flow fan sprayers, which can be optimally adjusted to the canopy wall.

Alley widths of 1.8 – 2.2m require a precise calculation of the liquid amount, otherwise too much pesticide per hectare will be used.

Developments in the application technique

Until the 1960s pesticides were applied with a spray gun and a long hose or from a work platform attached to the tank.

Gradually, this application technique was replaced by air-assisted sprayers. As long as trees on vigorous rootstocks with a height of up to 6m had to be treated, axial fan sprayers with a large air volume of up to 70,000 m³ per hour were indispensable. The fan was not operated by a cardan shaft but by a separate engine, which made the sprayer difficult to manoeuvre.

Sprayer inspection in the South Tyrol since 1991

In 1991 the South Tyrolean Extension Service decided to introduce sprayer inspections according to the Styrian model. We were assisted by Mag. Karl Lind, whose help proved very valuable.

When we bought three sprayer testing facilities in 1992, a new era began for the application of pesticides in South Tyrol. The purchase of the three testing devices was funded by the South Tyrolean fruit and wine industry and they were consigned to the South Tyrolean Extension Service. We gave the testing facilities to three mechanics, who perform the tests on their own behalf. The prices are fixed consensually with representatives of the South Tyrolean fruit and wine industry. At present a sprayer inspection and calibration costs 123 Euros plus 21% VAT. The mechanics are trained by experts from the Extension Service and their services are officially acknowledged by the Department of Plant Protection of the Autonomous Province of Bolzano.



Fig 1. Test bench for the measurement of the flow rate of each nozzle (left) and of the liquid distribution (right).

Sprayer checks are mandatory in the South Tyrol

Initially, the sprayer checks were optional. From 1997 onwards they became mandatory in 5-year intervals for all growers that wanted to participate in the South Tyrolean IP-programme for pip fruit. Now, a sprayer check every five years is a condition for the GlobalGAP certification of our operations. In addition, the GlobalGAP standards demand an accurate calculation of the liquid amount and an annual calibration of the sprayers. At present approximately 95% of our operations meet these requirements. At first sight this seems to be a liability but it brings with it a recompense. Participants in the AGRIOS-programme get direct or indirect EU subsidies of 1,200 Euros per hectare. GlobalGAP certification is a condition for being able to hold one's own in the globalized apple markets.

What is measured during a sprayer test?

The flow rate of each nozzle, the accuracy of the manometer, the liquid distribution, the tractor speed in different gears and the rotation speed of the PTO shaft are checked.

The filters, the tank agitator and the water conducting tubes are optically assessed.

During the inspection defects are, if possible, fixed on the spot. Ideally, only sprayers that have passed the test can leave the testing centre. If the defects cannot be repaired immediately, the sprayer has to be taken to a service station and checked again afterwards.

A complete inspection usually takes 2 hours. In order to avoid long waiting times the grower has to register at the Extension Service or at the sprayer testing centre and to submit his or her personal data, details about the sprayer, the nozzle type, the training systems in the respective orchards or vineyards and the canopy height.

After the tests the results are transmitted via the Internet to a server which can be accessed by the technicians of the South Tyrolean Extension Service. Based on these data we work out together with the grower an instruction sheet on the application of pesticides in his or her orchards and vineyards. In order to be able to better adjust the air amount of the sprayers to the tree volume and the canopy wall of the vines an air flow testing stand was acquired in 2011.



Fig. 2. Nozzles used in South Tyrol for air-assisted sprayers.

Before 1992 most sprayers in South Tyrol were equipped with ceramic nozzles with a small metallic dosing plate. In the course of the sprayer inspections most sprayers were fitted with Albuz ATR hollow-cone nozzles from 1992 onwards, and their air flow is checked every five years. Our next step is to convince all growers to replace at least the three topmost nozzles with drift-reducing air induction nozzles.

At present about 6,000 sprayers are in use in South Tyrol. Most of them are checked every 5 years at the sprayer testing centres. When a south Tyrolean fruit- or winegrower buys a new sprayer, it is customary to stipulate a sprayer test in the sales contract.

Spray liquid amount

We calculate that the water amount required per metre tree height and hectare is 500l. Therefore, if the trees are 3.5m high, 1,750l of water are needed. Nowadays no grower in this area would apply a pesticide in the "normal volume" concentration because it would be too time-consuming, the coverage would be poorer because of the larger droplets and the runoff losses would be too high. By now, the majority of the South Tyrolean growers has adopted low volume spraying with 350 – 580l of water per hectare, which means that the concentration of the spray liquid is five to three times higher.

Project "Low-Loss Spraying"

Since 2011 the South Tyrolean Extension Service has taken an active part in the project "Low-Loss Spraying". We hope that the Italian legislative will acknowledge that this application technique is a drift-reducing measure, as the Austrian and German authorities have already done.

A reliable inspection protocol is absolutely essential for the exact calculation of the liquid amount per hectare. The growers usually need the help of an expert so as not to apply too large or too a small quantity of a pesticide. On the basis of these measurements our technicians can work out together with the growers an instruction sheet that is custom-tailored to their orchards or vineyards. In accordance with the planting systems used in the operation it contains exact details about the optimal liquid amount per hectare or for the size of the individual orchards or vineyards, the ideal driving speed, the number of nozzles to be opened, the pressure and the rotation speed.

Reducing drift – a must



Fig. 3. Applying pesticides in urban areas is a sensitive issue.

Since the beginning of this year the South Tyrolean growers have been faced with a new challenge. The South Tyrolean local government has issued new guidelines regarding the distances to be kept to neighbouring properties when applying a pesticide. They are binding for a community if it wants to issue a regulation for its territory. A similar regulation was included in this year's IP-guidelines for pip fruit in order to minimize drifting from orchards into nearby pastures and area under grain or herb cultivation.

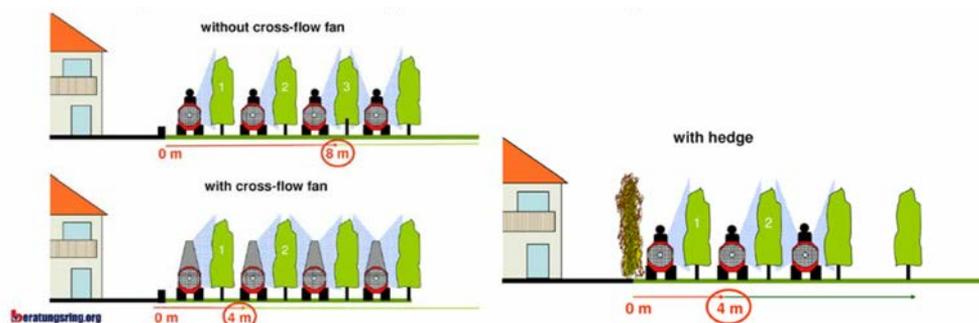


Fig. 4. Regulations regarding the distances to residential and public areas in South Tyrol.

These guidelines and regulations had become necessary because not every grower exercised enough care when applying pesticides with an air-assisted sprayer near residential areas, public facilities, pastures and grain or herb fields. The guidelines provide that when spraying an orchard with an axial fan sprayer the last 8m along the orchard borders have to be treated in the direction of the interior of the orchard. If a sprayer with a cross-flow fan is used, however, the distance can be reduced to 4m. If the orchard is bounded by a hedge, the distance from the borders within which the pesticide has to be sprayed towards the interior is also 4m.

Our IP-guidelines for pip fruit also require that from 2012 onwards if a new orchard which borders on a meadow, or a grain or herb field is planted, a minimum distance of 3m from the boundaries has to be observed and at least 5m have to be calculated for the headland, where the tractor is turned around.

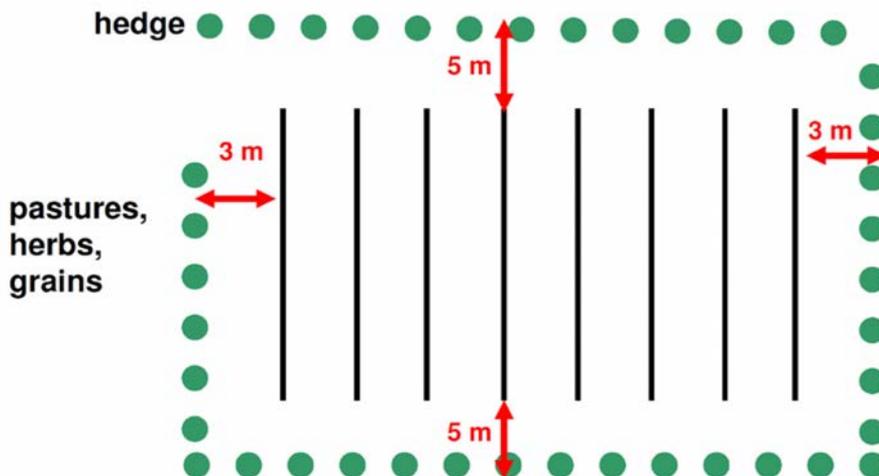


Fig. 5. Distances to pastures and areas under grain and herbs cultivation.

Additionally, a hedge of at least 2m in height has to be planted along the orchard border. New sprayers which are used next to private gardens or public facilities have to be fitted with a cover plate. How is this recorded? The test centres attest in the inspection protocol that a sprayer is equipped with drift-reducing devices.

Conclusions

- Technical defects which are detected during the inspection are, if possible, repaired immediately. This has considerably improved the technical condition of the sprayers in circulation in South Tyrol today.
- In the consultations before and after the sprayer inspection we manage to convince most growers to switch to low volume spraying. This has increased the coverage rate of the foliage and therefore the efficacy of the pesticides and reduced losses due to runoff.
- Almost all South Tyrolean sprayers feature Albus ATR hollow-cone nozzles. This allows an accurate calculation of the liquid amount per acreage and tree height based on various parameters.
- By using a vertical test stand we managed to adjust the liquid amount better to the tree height and canopy volume in the individual orchards.
- As of recently it has also become possible to measure the air flow. In this way we hope to further increase the efficacy of the pesticides and decrease drifting.
- We will try also in future to make sure that our sprayer inspection programme keeps pace with the latest technological advances. Therefore we are very pleased that you have chosen South Tyrol as venue for this 4th SPISE-workshop and hope that this will provide us all with stimuli to further improve our spray application technique and sprayer testing methods. Finally, I would like to appeal to the Italian authorities to integrate the application technique of “low-loss spraying” into the National Action Plan.