

## Towards integration of inspection procedures, calibration and drift reducing devices for an efficient use of pesticides and reduction of application impact

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DOI 10.5073/jka.2012.439.019

### Summary

The fruit production of Trentino is an important industry of the local economy with a gross marketable production of about 215 million Euros with almost 75% comes by apples.

The characteristics of the cultivation environments allow to get quality products. This is made possible by the constant technical updating operated by technical support of Consulting & Services Centre – CTT. This is one of reasons why IPM has come in the practice since the early 90's and on this view the inspection of sprayers is mandatory and regularly made with five years interval.

Many housing districts are scattered among orchards and population of rural surroundings has become more and more sensitive to issues about environmental sustainability and spray drift. Therefore vertical bench tests started to follow the standard procedures of inspection and calibration to carry the operators to a more efficient way of application reducing drift losses.

Moreover in the last years has become needful to start a series of test in order to find technical solutions for drift mitigation. In our view the next step to allow an adequate and efficient use of drift reducing devices, and bring them in the practice, is to link inspection and calibration with drift reduction experiences. Informations, suggestions and adjustments are achievable by the technical staff of the inspection facilities (e.g. choice of a proper filter mesh size according with the nozzle type, etc.) during inspection activity. On this view training during inspection has a key role to make the operator conscious of the most appropriate technical choices for efficient use of pesticide application equipments.

### Introduction

The fruit production of Trentino is an important industry of the local economy with a gross marketable production of about 215 million euros with almost 75% comes by apples. The characteristics of the cultivation environments allow to get quality products. To further enhance the quality of these productions, since the early 90's IPM has come in the practice. On this view the Association of Fruit and Vegetable Producers in Trentino (APOT), in co-operation with the Province Government and Technical Support Team of Edmund Mach Foundation, decided to get in practice the mandatory inspection of sprayers which regularly made with five years interval for all its associates.

In fact the main problem related with the quality of treatment was an unsatisfactory level of effectiveness on the top of plants. This has been attributed to the inadequate amount of deposit produced in the upper leaves and fruits during treatments due to the inefficiency of equipments used by the fruit growers. Deposition on canopy profile must be as homogeneous as possible according with the shape of trees to achieve good efficacy and in this way it was also necessary to place beside a calibration activity immediately after inspection.

### Patternator calibration service provided by the mobile workshops in Trentino (bench calibration)

Calibration is necessary for spraying to ensure targetted, optimal use of PPP, minimize risk to the crop, consumer and environment and to avoid excess spray liquid at the end of the spray job (ANDERSEN & JØRGENSEN, 2009). This important operation has long been an integral part of the inspection service in Trentino.

Once the sprayer has passed the inspection, on the basis of information provided by the user of the equipment, the technical staff of the inspection center fills out an information sheet containing the types of crops in the farm, the characteristics of trees and planting systems (distance between the rows and average height of the plants) and the specific working parameters employed (e.g. number of working nozzles, forward speed, PTO speed, concentration of the spray liquid).

Then a verification of the profile of distribution is carried out to the vertical patternator. When the symmetry between the left and right of the diagram is not sufficient or when the amount of liquid collected in the top of the bench is low the operator performs a correction of nozzle position by changing the inclination of the jet or when possible by moving nozzles on the boom. Through these operations is intended to improve the homogeneity of deposition profile on the foliage considering the crop characteristics.

At the end of the procedure two more records are released containing the optimal working parameters to be used for each of the cultivated species by the farm and the results of the vertical bench test, before and after the adjustment operations.

Where the equipment is partially or fully fitted with air injection anti-drift nozzles, the user may ask for the bench calibration is also done with such type of jets. Moreover informations and suggestions are achievable by the technical staff of the inspection facilities (e.g. choice of a proper filter mesh size according with the nozzle type, etc.) during inspection and calibration activity.

### Adjustment of equipments on the canopy characteristics: past experiences and future perspectives

Apple growing in Trentino is characterized by such a number of varieties, methods of cultivation, planting distances and attitude of plots as to put it among the most elaborate and complex cultivated areas. This situation often requires the same grower to operate in very different contexts, both for planting density and size of vegetation (Fig. 1). That means, for the operator, difficulty in identifying the proper spray volume and doses of agrochemical depending on the operational situation.

With the aim to adjust the dose of plant protection product together with the appropriate spray volume considering orchard development characteristics (Crop Adapted Spraying), since 2004 a pluriannual series of experimental trials has been carried out in Trentino. Current results allow to make out useful parameters to apply the Tree Row Volume model (TRV). Infact the recent renewal of old (tall) plantings with modern orchards, consisting of smaller trees, require a new approach on application. The reference crop volume for the investigated orchard scenery is 12,000 m<sup>3</sup>, which corresponds to a label-recommended dose for 1,500 l/ha of spray volume (standard volume) (LORIATTI *et al.*, 2009; BONDESAN *et al.*, 2010).

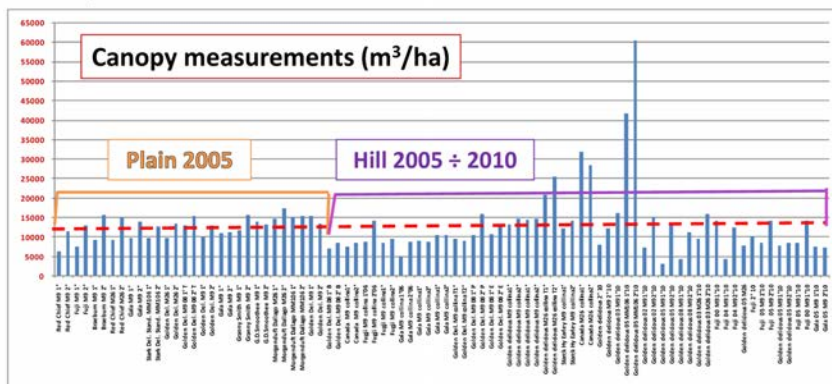


Fig. 2. Example of TRV-index evolution in plain and hill environments of Trentino: early (1) and full season (2) stage.

The most recent activity was intended to introduce in the practice of various farms the Tree Row Volume model which allows to calculate the amount of pesticide and the optimal spray volume for the existing vegetation so the farmer can obtain the quantities of pesticide to be applied in each of its plantings to avoid overdosing and adopting a more rational treatment. During the season 2011, as done in 2010, the farms involved have identified some plots where they proceeded to carry out the treatments on the basis of the parameters resulting from the application of the TRV model, by varying the dose delivered from the beginning of the flowering season, up to maximum vegetative growth. Preliminarily the farmers provide their application equipments for the inspection and vertical bench calibration test according to the operating parameters provided by themselves. Even in the last year, the comparison between the results of efficacy in plots treated with the standard method and TRV, has highlighted no substantial differences.

Training activity is ongoing in 2012 but after two years of teamwork with farmers we concluded that they are interested in calibration tools to adjust the sprayer according the canopy characteristics but they ask for simple tools.

So, reference tables with application volumes, based on field TRV measurements along the season, on different varieties, cultivation environments, etc. are intended to be created as already done in the past in other cultivated areas around the world (FURNESSE et al., 1998; VIRET et al., 1999).

### Importance of calibration on the reduction of drift

Another characteristic of the rural environments in Trentino is the close proximity of residential and cultivated areas. Many housing districts are scattered among orchards and population of rural surroundings has become more and more sensitive to issues about environmental sustainability and spray drift. So, over the years has created the need for regulations to allow the coexistence between fruit growing and non-agricultural activities.

Subject to appropriate conditions of wind and temperature, a proper calibration of working parameters allows among other advantages, immediate and effective waste reduction (BALSARI et al., 2007; DORUCHOWSKI et al., 2012).

From some recent experimental trials, carried out by comparing equipments with traditional and anti-drift nozzles, has emerged that the maximum degree of reduction in eso-drift losses was obtained by appropriate adjustment of the airflow related to the forward speed of the sprayer and the characteristics of the canopy structure (Fig. 2 and Tab. 1).

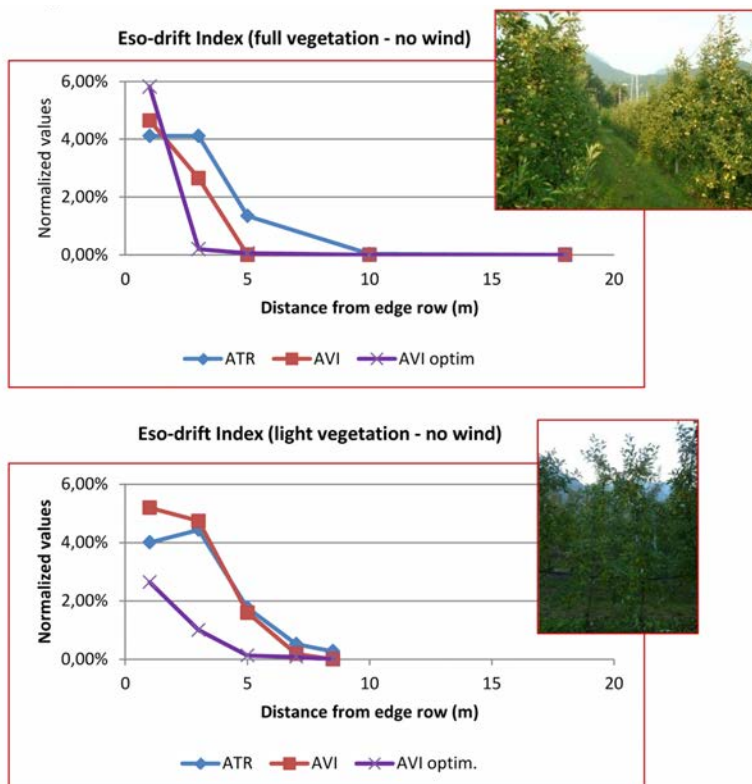


Fig. 3. Effect of sprayer adjustment associated with air injector nozzles (AVI optim.) on drift mitigation: comparison during different development stages of the canopy.

Tab. 1 Main working parameters and conditions during drift tests in 2009.

Equipment	Type and number of nozzles	Pressure (bar)	Operative speed (km h <sup>-1</sup> )	Estimated airflow rate (m <sup>3</sup> h <sup>-1</sup> )	Canopy characteristics
Tower sprayer + ATR + standard airflow rate	Swirl cone 8+8	6.0	6.5	36,000	Full & light vegetation
Tower sprayer + AVI + standard airflow rate	Flat fan air injection 8+8	6.5	6.5	36,000	Full & light vegetation
Tower sprayer + AVI + adjusted airflow rate	Flat fan air injection 8+8	6.5	6.5	19,000	Full vegetation
Tower sprayer + AVI + adjusted airflow rate	Flat fan air injection 7+7	4.5	6.2	19,000	Light vegetation

The evaluation of the correct airflow rate based on field conditions is often difficult to achieve for the farmer. The past difficulties in obtaining a sufficient product deposit in the higher part of the canopy lead the operator to use excessive airflow rates than necessary. For these reasons in the near future will be important to look into this aspect during the training courses organized by the Extension Service of the FEM, which have long proposed to farmers technical meetings on the correct application practices (Fig. 3). The “on field” training approach may allow the one operator to learn from the mistakes of the other and also select the proper fan speed on the basis of the orchard characteristics.



Fig. 4. “On field calibration” meeting organized by the Extension and Experimental Service of FEM in Trentino.

## Conclusions

Calibration procedure is one of the more influence factors affecting the final success on spraying application (GIL & GRACIA, 2007). Often farmers seem to willingly accept the obligation of inspection thanks to the opportunity given them to calibrate the equipment.

During inspection activity few technical informations and suggestions are achievable by the technical staff of the inspection facilities. This is important also because of the farmer is not familiar with drift reducing devices, that will be even more required during application practices when the Directive 2009/128/EC will be implemented in the Italian legislative system. On this view training during inspection has a key role to make the operator conscious of the most appropriate technical choices for an efficient use of the pesticide application equipment.

Inspection, calibration and drift reduction are strictly linked one each other. Through the constant training and updating of users, these elements can lead the farmer to a higher awareness on how to accomplish a sustainable use of plant protection products.

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