FINE-TUNING FUNGICIDE APPLICATION:

A new perspective on the control of post-harvest decay in stone fruit

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Fungicidal post-harvest decay control in fruit is standard practice in stone fruit production. However, if different methods of fungicide application are used it may result in varied levels of fungicide efficacy. Here we present information on a study evaluating the impact of fungicide application methods on decay control.

Post-harvest decay is an age-old and universal stumbling block in fruit production. An early 19th century researcher aptly described it as "the meanest of subjects" and that "fruit sometimes rapidly passes into a moist loathsome mass" (Anonymous; 1850). It is indeed mean and loathsome, but more so, for the continuing battle for producers to get the upper hand in decay control. Decay remains an impediment in the profitability of fruit production and this calls for the generation of scientific knowledge to continually improve decay management efforts.

In stone fruit, two important fungal pathogens are responsible for post-harvest decay. *Monilinia laxa*, which causes brown rot and *Botrytis cinerea*, responsible for grey mould. Both fungi are present in the orchard and pre-harvest infections may take place as may postharvest infection. However, the greater part of infections become visible as decay during cold storage. In packing-houses, fungicides are applied either by drenching fruit, or with an atomiser. Atomisers deposit the fungicide spray mixture, through spray nozzles, as a mist of small droplets on the fruit. Peaches and nectarines, are packed and stationary fruit on trays are transported through the spray apparatus on a conveyor belt, whilst plums, being a more hardy stone fruit, generally roll over the conveyor belt and is packaged after fungicide treatment.

An important principle in fungicide efficacy is effective coverage of the target area. Since a variety of methods, products and technologies are used to apply post-harvest fungicides in stone fruit, it can be assumed that the successful coverage of product on fruit surfaces will vary. In various crops, the importance of optimal fungicide application techniques, and notably the high variance in the deposition of product when using different spray apparatus, nozzles and rates of application have been documented (Pascal et al., 2010).

In the light of the above, an investigation to test decay control efficacy of two registered fungicides when applied under varying conditions on stone fruit was conceptualised. The aim of the study was to investigate if it was possible that variation of the application methodologies of the same fungicide product could result in varied levels of decay control. The goal was not only to observe if differences could be measured, but also to estimate if such differences are of such extent

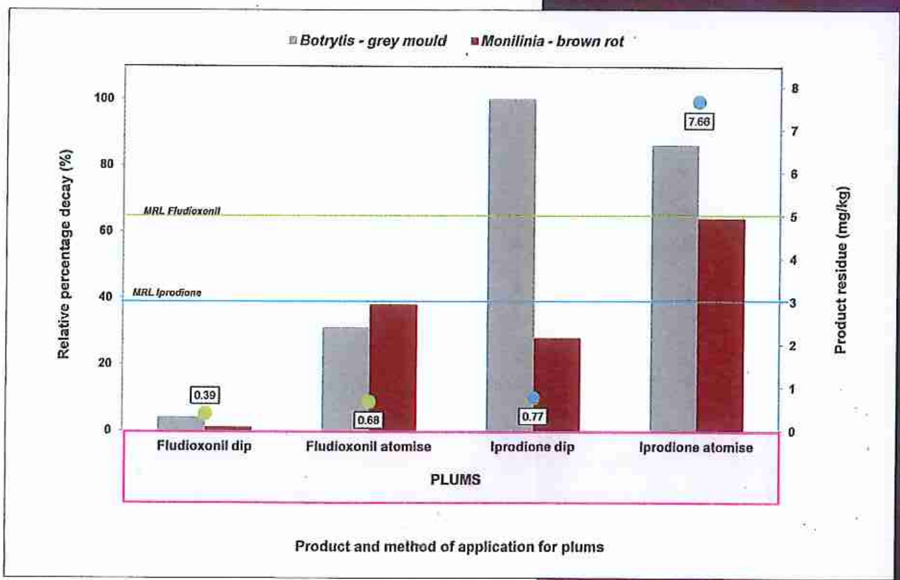
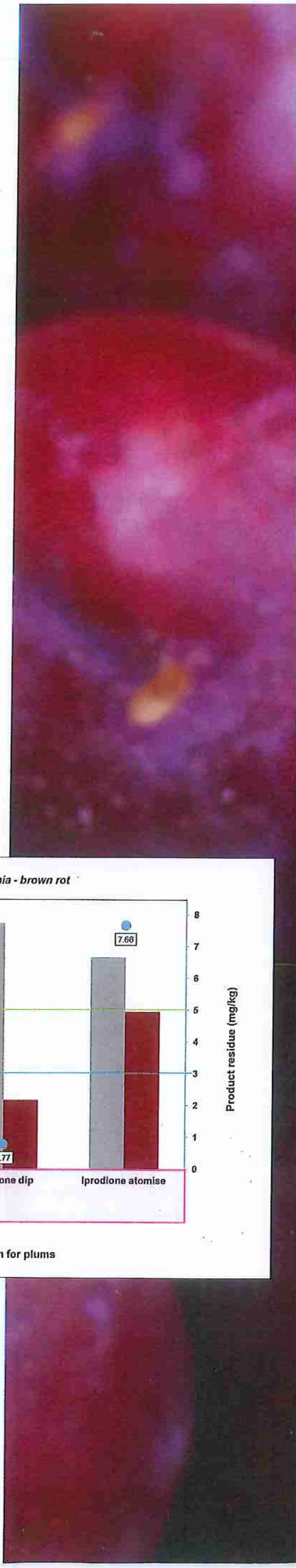


Figure 1: Relative percentage decay of plums treated with Fludioxonil or Iprodione either with and atomiser or by dipping fruit into the product solution, with the resulting chemical residue indicated (green and blue dots for Fludioxonil and Iprodione, respectively).



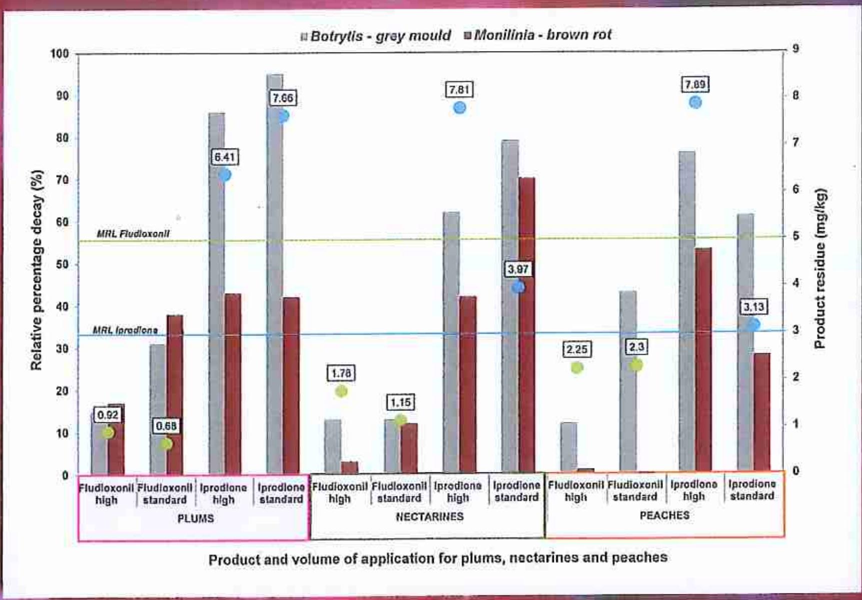


Figure 2: Relative percentage decay of plums, nectarines and peaches treated with Fludioxonil or Iprodione, at two different fungicide solution volumes (high and standard), applied using an atomiser, with the resulting chemical residue indicated.

that variation of current fungicide methodologies warrants further investigation. Consequently, generation of additional data will allow guidance towards fungicide application approaches which might boost the success of post-harvest decay control in the stone fruit industry.

To execute this study, plums, nectarines and peaches were injured and inoculated with either *Botrytis cinerea*, or *Monilinia laxa* to induce grey mould and brown rot decay respectively. Fungi were allowed to infect the fruit for 4 hours, before fungicides were applied. This resulted in exacerbated levels of decay. The reasoning behind the severe induction of decay was that decay control by registered fungicides ought to be 100%. In order to study the variation in fungicide efficacy under different conditions, the fungicide needed to be challenged to its limits. Such extreme decay in the fruit would allow the measurement of variances in the decay control for different treatments. Thus levels of decay indicated in graphs are to be seen as "measuring sticks" for efficacy, and

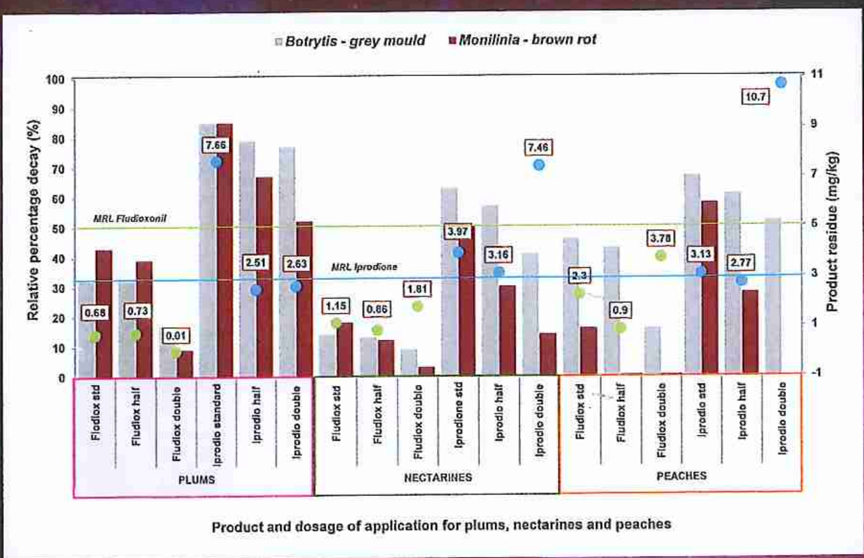


Figure 3: Relative percentage decay of plums, nectarines and peaches treated with Fludioxonil or Iprodione, at three different dosages of fungicide solution (standard, half and double), with, applied with an atomiser, with the resulting chemical residue indicated.

not as actual values for the efficacy of that treatment under industry conditions.

For the plums, two methods of application, viz by atomiser or by dipping fruit in fungicide solution was investigated (Figure 1). This part of the study was restricted to plums only, since peaches and nectarines cannot be submerged in a fungicide solution, due to the soft nature of the fruit.

For all three fruit types the effect of two volumes, standard (1.2 L / ton of fruit) vs high (3 L / ton of fruit) (Figure 2), and three dosages *viz* half, standard or double (Figure 3), of fungicide were studied as applied with an atomiser. The fungicides tested were "Scholar®" (a.i. Fludioxonil; standard dosage 8.3ml / L), and "Rovral®" (a.i. Iprodione; standard dosage 11ml / L). After fungicide treatment, fruit were cold stored at -0.5 °C for four weeks, moved 10 °C for four days to simulate shelf life before brown rot and grey mould decay was evaluated.

Decay evaluations data were used to calculate a "decay index". The decay index is a measure of both the severity, thus the surface area of decay occurrence, as well as the incidence, meaning the number of the total amount of fruit that were decayed. This index is therefore an overall estimate of the magnitude of decay in a fruit type for a given fungicide treatment. As explained earlier, the induced decay was exceptionally harsh, this was done to allow comparison of treatments.

In order to level the playing field for all treatments and fruit types, a relative decay index value (as a percentage) was calculated. For instance, if the decay index of untreated fruit was 50% and for fruit that received fungicide treatment the decay index was 20%. The control fruits' decay index value was converted to 100%, and that of the fungicide treatment to 40%. So also where the decay index for control fruit was 25%, and that of fungicide treatment 5%, a conversion to 100% for the control, resulted in a disease index of 20% for the treatment.

This conversion of untreated control fruit decay index values to 100%, allowed direct comparison of product performance over the two pathogens and the three fruit types. These mathematical calculations further inflated decay index values. Data only allows comparison of product performance under certain conditions (and does not reflect on fungicide efficacy under commercial conditions for uninoculated fruit). For ease of interpretation of the data, these relative decay index values will be referred to as "relative percentage decay" in the graphs.

Generally, the different application methodologies distinctly influenced decay control. For instance, for brown rot decay, the dipping of inoculated plums in either of the fungicide solutions resulted in significantly less decay than when fungicides were applied with an atomiser (Figure 1). For grey mould, dipping in Fludioxonil also gave better control than the atomiser application. However, little distinction in the levels of grey mould control with Iprodione using different methods was apparent. Moreover, fungicide residue levels were lower in fruit dipped in fungicide solution.

Adjustments in fungicide solution volumes also notably influenced the levels decay control observed. Particularly for grey mould on plums and peaches, decay control was greater at a higher volume than standard volume application of Fludioxonil (Figure 2). Similarly, for brown rot on plums and nectarines, the high volume application of this product resulted in greater decay control. This effect was also seen for the application of Iprodione to nectarines for both pathogens.

Comparisons of dosages of products should not be made, since the only use of registered dosages is permitted. The data was generated to gain insight on the product residue that may be encountered when inadvertent under or over dosage of product occurs. Residue values for Fludioxonil (green dot) always remained below the maximum residue limit, whilst for Iprodione (blue dot), on nectarines and peaches, the residue was over the limit in 5 of 6 instances (Figure 3).

Results from this study indicate that decay control strategies should not solely rely on the use of available products, but that decay control may be optimised by refining and optimising application methods and technologies.

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