

Fine tuning a rapid method to determine the concentration of prochloraz in the fungicide bath and best practices for the use of prochloraz in the mango pack house

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ABSTRACT

Prochloraz is important for the control of anthracnose and extended shelf life of mango and it is therefore necessary to ensure that prochloraz concentrations are always sufficient in the fungicide bath. A method to measure prochloraz concentrations was developed. During the past season the method was fine tuned. The turbidity method is effective, quick and easy to do and gives a good indication of the prochloraz concentrations while the measurements can be performed by any pack house manager. A table with graph was developed to be used together with the turbidity meter.

Additionally, concentration rates of prochloraz were evaluated, as well as the effect of pH on the efficacy of prochloraz. It was clear that for mango 180 ml Chronos /100 L water should be used at all times. The lower dosage of 90 ml Chronos/100 L water is simply not good enough to control anthracnose effectively especially with a contact time of 20 to 30 seconds. Reduction of pH to enhance prochloraz efficacy was not effective. When the bath water was reduced to pH 4, more fruit developed anthracnose compared to the bath water of pH 7. Prochloraz levels also dropped drastically when bath water was left overnight and re-used the next morning. It is recommended that the bath water be renewed daily. Additionally an improved water rotation system should be used in the bath as this will help with suspending the prochloraz in the water again after it has precipitated overnight.

INTRODUCTION

After harvest, prochloraz (Chronos 45 EC 450g a.i.) is used in the mango pack house as a post-harvest chemical for anthracnose control (Van Zyl, 2011). However, in the past problems have been observed relating to the efficacy of prochloraz in controlling anthracnose due to a range of reasons which could include pH variations of the solutions (Cunningham, 2010; Zagory, 2000), organic matter in the water, temperature (Kupferman, 1984) and build-up of bacteria (Serfontein & Serfontein, 2006; Swart *et al.*, 2004). Because bulk amounts of fruit are handled in the pack house, prochloraz concentrations need to be topped up regularly. However, because of the above mentioned reasons it is not easy to determine the amount of chemical to be added (Swart & Van Broekshuizen, 2003; Serfontein *et al.*, 2006; Daneel, 2011).

To ensure effective control of the disease it is important that the correct concentration is present at all times in the fungicide bath. If a direct method is de-

veloped that is user friendly and easy to execute in the pack house, managers would be able to test the water throughout the day and add prochloraz depending on the reading. Currently, recommendations state that prochloraz should be added regularly if bulk amounts of fruit are being handled (Daneel, 2011). However, it is clear that prochloraz concentrations vary considerably during the day between early morning, before topping up and after topping up. Not only might the amount of chemical used be cut considerably, but it will also reduce the risk of excess residue levels on the fruit at any time during the day and it will provide efficient anthracnose control throughout the day.

During the previous season a rapid method was developed to measure prochloraz concentrations but needed to be fine-tuned. This method consists of measuring turbidity of the water using a single beam portable turbidity meter. Prochloraz emulsifies and suspends in water, resulting in turbidity of the solution. When the concentration of prochloraz is reduced, turbidity units are reduced. Additionally, the



effect of pH, temperature and prochloraz dosage were determined as well as the effect of leaving the water overnight.

MATERIAL AND METHODS

Verification of turbidity method in the pack house

Several pack houses were visited in the Limpopo Province, South Africa. In each pack house a calibration curve (Fig. 1) was prepared by using the water of the specific pack house. Due to differences in electrical conductivity, pH and organic material of the pack house water the calibration curve needed to be prepared for each pack house. This calibration graph was then used to determine the concentration of prochloraz in the bath during the day. Samples were taken hourly or every two hours throughout the day, recording number of fruit handled, pH and temperature as well as time and amount of prochloraz added to the fungicide bath.

Effect of pH

At Bavaria pack house, the effect of pH was determined by lowering the pH in one of the pack lines to 4 while the other pack line had a pH of 7.5.

Effect of prochloraz dosage

At Bavaria pack house the effect of prochloraz concentrations was determined by using 180 ml Chronos /100 L water in one pack line while the other pack line had 90 ml Chronos /100 L water.

Effect of not renewing fungicide bath daily

The effect of leaving the fungicide bath overnight was determined by measuring prochloraz concentrations the following day before starting to pack.

RESULTS

Verification of turbidity method in pack house

With the turbidity method clean water has a reading of 0. However, when water has impurities the reading increases. This value must be deducted from the value measured when calculating the turbidity of the solution. It is best to draw a calibration graph for each pack house separately as this includes the effect of impurities, pH and electrical conductivity (EC) of the water.

Because the turbidity of prochloraz concentration for export (900 ppm Chronos 45 EC/100 L water or 180 ml /100 L water) (Van Zyl, 2011) is too high to be measured with the turbidity meter, a dilution of 1 to 4 or 5 is necessary. To make the measurements in the pack house easier, all solutions taken during the day from the fungicide bath can be diluted 1 to 4 or 5. However, if the concentration drops too low it might be better to use a 1 to 3 dilution rather than a 1 to 4 because readings between 300 and 600 NTU (measurement for turbidity) are preferred. The calibration graph with an additional table which depicts the parts per million (ppm) of the solutions will show what ppm corresponds with the reading. Another column will show the amount of prochloraz that needs to be added to the bath. This information which is not

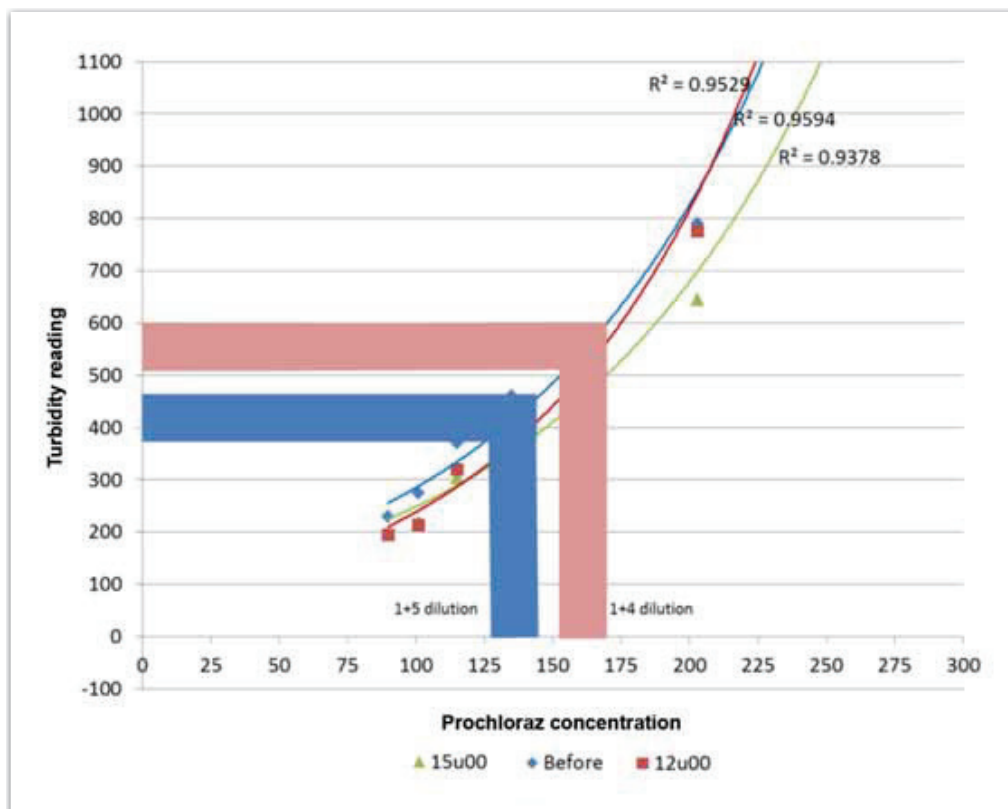


Figure 1. Calibration graph for prochloraz concentrations.

shown here will be given to each pack house.

Turbidity readings are not able to determine the exact concentration of prochloraz but they can estimate the concentration and give a very good indication of whether it is below a certain level in which case prochloraz needs to be added.

Results (data not shown) obtained with the turbidity meter were compared with the results of the biological method (Serfontein *et al.*, 2006) as well as the high performance liquid chromatography (HPLC) method and revealed similar results for all tests. This proved the viability of the turbidity method.

The effect of pH

When pH was 7.5, the fruit quality was far superior (10% anthracnose) to the fruit dipped in the fungicide bath with pH 4 (50% anthracnose). It is therefore clear that acidifying the water has no benefit.

Effect of prochloraz dosage

With the lower prochloraz dosage of 90 ml Chronos/100 L water more than 90% of the fruit developed anthracnose after two weeks compared to less than 10% for the 180 ml Chronos/100 L water dosage. It is clear that the lower dosage is insufficient to control anthracnose. It must be remembered that the 90 ml Chronos/100 L water dosage was registered with a contact time of 2 minutes for fruit sent to local markets. This is a far longer requirement than the 20 to 30 seconds that fruit is actually dipped in most pack lines. For mango fruit to be protected against anthracnose for an extended period, fruit must be dipped in 180 ml Chronos/100 L water concentration.

Effect of not renewing fungicide bath daily

Prochloraz precipitates and very low concentrations are measured the next day even after fruit has gone through the pack line and water was supposed to be stirred vigorously. The amount of prochloraz to be added to the water left overnight to reach the 180 ml/100 L water concentration is practically the full dosage. Furthermore, the water gets dirty during packing, increasing the chances of developing bacteria and other organisms.

CONCLUSION AND RECOMMENDATIONS

- The rapid turbidity method developed can be used in the pack house to determine prochloraz concentrations.
- The pH of the water should not be altered, as better results were obtained with a higher pH.
- The concentration of the prochloraz used should be 180 ml Chronos/100 L water irrespective whether fruit is exported or sent to the local markets as anthracnose control is very limited with the lower dosage.
- The fungicide bath should be replaced daily as pro-

chloraz precipitates and it is very difficult to get it into suspension again. If the water is not replaced daily, the pack house should consider the installation of a rotation system in the water.

- During the study it was seen that higher temperatures did not have an effect on the solubility of the prochloraz. However, when water was very cold (something probably not happening during the mango packing season) the product did not dissolve as well as during ambient temperatures.

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