Prediction of harvest dry matter in ‘Hayward’ kiwifruit

A model for prediction of harvest dry matter (DM%) in the Te Puke region, based on seasonal temperatures, has become progressively less accurate over the period 2007 to 2010. Growers have consistently achieved higher DM% results than predicted over this period, suggesting that management tools for improved dry matter have been widely adopted and have improved the DM% of ‘Hayward’ fruit. Consequently, we have developed a new model that attempts to:

- Take into account changing vine management
- Take into account the effect of variation in seasonal rainfall and/or soil moisture.

Dry matter data used for earlier models included averaged data from five Satara orchards for 1997-2001, industry averages for the Te Puke region 2002-2003, and averages of 197 maturity areas in the Te Puke region 2004-2006. For the new model, this data set was extended by adding averaged industry data from 2007-2010. Kiwistart orchards were omitted, and only final clearance data were used, so that data were representative of “main harvest” dry matter.

Weather data were extracted from NIWA’s CliFlo database, which is a web system that provides access to New Zealand’s National Climate Database. The average spring, summer, and autumn temperatures along with average rainfall and soil moisture values were used to develop the model.

We showed that, in addition to seasonal temperature effects, summer rainfall and soil moisture also affect harvest DM%, with higher rainfall or soil moisture leading to a lower DM%. However, we also found that since 2005, when Taste ZESPRI® was implemented for all growers, there has been a significant improvement in harvest DM% that is not explained by changes in weather variables. We think this increase in DM% is due to changes in orchard management, such as the increased use of summer trunk girdling, and more low vigour pruning of vines. We calculate that these changes have increased the DM% by 1.2 units between 2005 and 2010. Using information from research trials and industry records of girdling, we estimate that 0.85 of those units were due to trunk girdling. This suggests that there has been an improvement of roughly 0.35 units due to other factors such as the implementation of low vigour pruning systems since 2005.

The model we have fitted to industry average dry matter percentage data from the Te Puke Region 1997 to 2010, is:

$$\text{DM}\% = 17.49 + 0.453 \cdot T_{\text{spring}} - 0.442 \cdot T_{\text{summer}} + 0.133 \cdot T_{\text{autumn}} - 0.277 \cdot \log(\text{Rain}) + 0.85 \cdot \text{NTG} + 0.35 \cdot \text{LVP}$$

Where $r^2_{\text{adj}} = 91\%$ and

- $T_{\text{spring}} = (T_{\text{Oct}} + 2 \cdot T_{\text{Nov}} + T_{\text{Dec}})/4$
- $T_{\text{summer}} = (T_{\text{Jan}} + T_{\text{Feb}})/2$
- $T_{\text{autumn}} = (T_{\text{Apr}} + T_{\text{May}})/2$
- $\text{Rain} = (R_{\text{Feb}} + R_{\text{Mar}})/2$
- $\text{NTG} =$ average number of summer trunk girdles (estimated at 1.0 in 2010)
- $\text{LVP} =$ Low Vigour Pruning score (average value 1.0 in 2010)
Thus warm spring and autumn temperatures are found to increase DM%, but warm summers and high rainfall decrease it. Predictions are for harvest dry matter but without any adjustment for the time of harvest.

A Microsoft® Excel® workbook has been developed which implements this model, enabling predictions to be made for a number of New Zealand regions, and providing comparison with historical data and predictions.

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