PREDICTING SWEET CORN MATURITY FOR FACTORY PROCESSING IN CANTERBURY, NEW ZEALAND

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Abstract

We have provided a service to McCain Foods in Canterbury for three years predicting the dates of harvest maturity of sweet corn for a succession of planting dates. Sweet corn development is calculated from thermal time at Lincoln. Adjustments are made to allow for changes in temperature associated with different locations and the possibility of warmer or cooler conditions.

Predictions based on prevailing conditions are updated each week, and have proved to be an accurate guide for the beginning of harvest, although less accurate for late-maturing crops. Since the service began, McCain agronomists have substantially reduced their time making crop observations, saving the company time and money.

Key words: Zea mays, thermal time, silking, harvest date.

Sweet corn is produced in mid and south Canterbury, from Lincoln (latitude 43.6^{o}S) to Timaru (latitude 44.4^{o}S), the southern-most margin for production in New Zealand. The mean growing season (late October - early March) temperature at Lincoln is 15.0^{o}C (SD 0.7^{o}C). The climate becomes progressively cooler going southwards. he high developmental base temperature (6^{o}C) for sweet corn (1) and relatively low temperatures in this region, cause maturity dates for similar planting dates to vary substantially among years. This causes problems for scheduling factory operations (1), and substantially increases the risk of crop losses through early frosts (3). However, it is possible to predict the range of maturity dates with increasing certainty as the season progresses (1). Here we describe a forecasting service that predicts harvest date from thermal time, compare predictions with actual harvest dates, and show how maturity date varies with location (2).

Methods

Prediction of harvest date was based on a thermal time accumulation of 1320^{o}C, base temperature of 6^{o}C (1).? Estimates of maturity dates for five sowing dates at ten day intervals were made each week using current temperatures from Lincoln until the day of prediction, then assuming either average conditions, or ?2^{o} C. Frost risk was assessed from analysis of 30 years of temperature data from Lincoln, and was assumed to vanish mid-way (in thermal time) between flowering and maturity. Results were provided to the company each Monday. Temperatures were logged near sweet corn sites throughout the region and compared with Lincoln temperatures over three years to determine whether standard corrections could be used. Observations of silking dates were made at weekly intervals in 1995, and actual harvest dates recorded.

Results

Observed silking dates were generally within one week of those predicted using Lincoln temperatures (Table 1 shows data from 1994/95 for five sites in the region). For early sown crops, predicted maturity dates were within a few days of actual harvests. However, predictions for crops harvested after 12 March became earlier by about 1.5 days/week (P<0.01) than the actual harvest (Fig. 1). The systematic departure may be associated with a non-linear response to temperature which becomes important near the base temperature (4) Additionally, at these temperatures crops mature very slowly and remain near optimum harvest condition for some time.

Site	Planted	Silking	Predicted	Difference (Days)
1	19 Oct	20 Jan	21 Jan	1
2	8 Nov	10 Feb	4 Feb	-6
3	7 Nov	13 Feb	8 Feb	-5
4	23 Oct	23 Jan	23 Jan	0
5	10 Nov	09 Feb	13 Feb	4

Table 1. Comparison of observed and predicted silking dates for 5 sites in Canterbury.

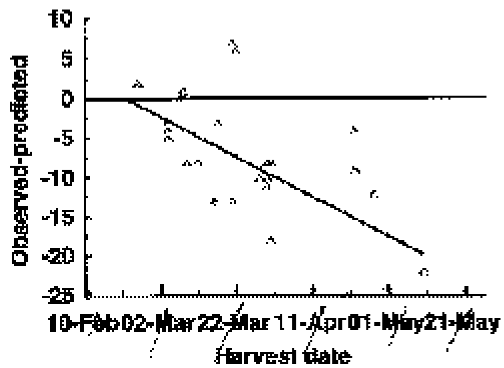

Figure 1: Difference between predicted and observed harvest dates compared to harvest date.

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Predicted harvest durations were about 30 days for a sowing range spanning 40 days in average conditions.? They were similar for warm conditions, but extended by 10 days or so in cool conditions (data not shown).? Actual harvest durations were longer, because late-maturing crops were harvested late, and because some crops were sown later than the latest sowing date used for predictions.

In the three years of the study, seasonal temperatures were near average, slightly warmer (+0.4^{o}C) and slightly cooler (-0.5^{o}C). The average change in harvest date for similar sowing times in the warmest and coolest years was between two and three weeks. Predicted frost risk was low, and no crops were lost. However, the seasonal temperature variation so far has been within one standard deviation of the mean, and it is nearly certain that larger variations will occur in the future.

Comparison among sites showed that Lincoln was warmest, and sites became cooler southwards and further from the coast. Sites fell into four groups based on mean temperatures. Those close to Lincoln had similar mean temperatures and the southernmost site was 1^{o}C cooler. The intermediate sites were classified into two further groups. Sites retained similar relativities among-st years, but this was not completely consistent. Hence the best temperatures to use for predictions will come from sites close to the crops. The 1^{o}C variation in tem- perature with location represents a delay in maturity of six days for an early sowing in an average season, but the delay increases in cooler seasons or with later sowings.

Despite increased uncertainty in predictions for later maturing crops, the company has developed sufficient confidence in the prediction service that they now begin crop observations only when harvest maturity is close.

Conclusions

Prediction of harvest dates of sweet corn from temperature data has proved to be a useful operational tool for forecasting harvest times and factory operations.? The system has saved the company time and money.

Acknowledgement

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