MODEL ANALYSIS OF VARIABILITY OF MAIZE POTENTIAL PRODUCTIVITY IN A COOL CLIMATE

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Maize production is expanding in cool-temperate regions which are marginal for reliable production of the crop. Low temperature can limit yield because both crop growth rate is reduced and growth duration becomes so long that crops fail to reach maturity in the available season length, and are frosted prematurely (1,2). The objective of this study was to quantify the effects of planting date and cultivar maturity on the yield potential and variability of maize under high input conditions in the cool-temperate climate at Lincoln, New Zealand (lat. 43° 39'S, long.172° 30'E, alt. 11 m).

MATERIALS AND METHODS

We used a radiation- and temperature-driven maize yield potential model (3) that had been modified to operate in cool-temperate climates (1). Yields were simulated for 6 planting dates from 1 October to 15 December with 30-year solar radiation and temperature data. Simulations were run for 6 hypothetical cultivars with maturity varied by changing final leaf number from 12 to 22 leaves. Plant population and individual leaf area were adjusted to achieve the same maximum LAI in all cases, thereby compensating for smaller leaf number and size in earlier maturity cultivars.

RESULTS AND DISCUSSION

Grain yield decreased as planting date was delayed for all cultivars, and yield was lower for later maturity cultivars. Results for the 18-leaf cultivar are in Fig.1. Yield variability was similar for all cultivars at each planting date, and variability was lowest with the earliest planting. The risk of producing zero yield increased with later maturity and as planting date was delayed.

We conclude that although potential yield is high at Lincoln, yield variability is also high. The variability was caused by quite small temperature differences near the threshold of the crop's range of adaptation, and by the high sensitivity of growth and development rates to temperature. Low yield and/or failure to reach maturity can be minimised by planting early and using early maturity cultivars.

Figure 1. Effect of planting date on grain yield of an 18-leaf cultivar. (Open bar = range between maximum and minimum, hatched bar = range between 25% and 75% quartiles, horizontal line = median).

REFERENCES

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