PREDICTION OF EFFECTS OF SOIL WATER AND NITROGEN ON BARLEY QUALITY FOR MALTING USING A SIMULATION MODEL

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Simulation models that predict grain quality can potentially be used to assist growers to optimise management especially when climate, soil water and soil nitrogen (N) are variable (1). Desired characteristics of barley grain for malting are grain N concentrations less than 2%, while maintaining large average kernel weight (KW). A previous study (2) has demonstrated the capabilities of a process level model that accounts for N and water effects and their interactions. The objective of the study was to examine the sensitivity of kernel weight and grain N concentration to varying N fertiliser management and rainfall using a simulation model.

METHODS

The model used was an adaptation of SWHEAT (3). It requires starting values for soil N characteristics, inputs for the crop at sowing, and daily maximum and minimum temperatures, solar radiation, and rainfall. The model was validated in the North Island of New Zealand under four N management treatments without irrigation. The effects on grain quality and yield were examined in simulations of seasonal variation using calculated deviations of -50% to +50% about the long-term mean rainfall and for different times of application of N fertiliser.

RESULTS AND DISCUSSION

Simulations of dry matter (total and grain) yield and crop N uptake agreed to within 10% of the field observations. There was close agreement between the simulated and the observed values for grain characteristics, although some over estimation of grain N concentration was found across the range of N treatments. Simulated grain N concentrations were 0.20 - 0.35% N higher than in the validation crop.

The simulations showed there were linear increases in grain N concentration up to the 2% level for the range of 0-100 kgN/ha of total fertiliser N irrespective of the timing of application. The pattern of response was dependent on the soil moisture. There was a 50% chance of exceeding 2% grain N in an average rainfall year with pre tillering N applications up to 200kg/ha. In drier conditions, the probability of high grain N concentration at harvest was higher. For rainfall 10% less than average the chance of grain exceeding 2% N increased to 80%. However, for rainfall 10% more than average the probability was reduced to 35%.

Simulated KW was unaffected by the level or timing of N application. However, the size variation was strongly influenced by soil moisture. A mean KW of 35 mg occurred when there was average rainfall. However there was a 90% chance of achieving mean KW less than 22 mg with 50% less rain. Alternatively, there was a 90% chance of achieving in excess of 40 mg KW if rainfall was 40% above average. Irrigation scheduling to match a 40% increase in the mean rainfall for the duration of crop growth would therefore result in high quality grain on both size and N concentration criteria.

REFERENCES

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