Options for improved biomass production in feeding systems for dairying in high rainfall environments in New Zealand

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Introduction New Zealand dairy production has expanded into marginal climates and soil types on the premise of excellent profitability and efficient utilisation of forage. Annual pasture production in the cool West Coast of the South Island (rainfall 2042-2933 mm) is <9000 kg compared with the national mean of 15,000 kg. Increased farm production and feeding of high quality biomass, from imported feed or supplementary feed crops grown on-farm, are needed to improve milk solid output. Small plot trials with spring and early summer-sown brassicas, cereals and maize were the focus for development of systems to maximise and manage the seasonal feed supply. The effect of sowing time, fertiliser timing and rate of N and K fertiliser application were studied to quantify the risks of crop failure in the high rainfall and low radiation environment. The aim was to increase forage supply/ha in a predominantly grass-based system and reduce associated risks to environmental sustainability.

Materials and methods Trials of cereals (triticale cv. Rocket and barley cv. *Boss*), maize (hybrid *Elita*) and brassicas (leafy turnip cv. *Pasja*, rape cv. *Maxima* Plus, and turnip cv *Barkant*) were sown at coastal Barrytown (BT) and inland Ikamatua, (IK) locations. The cereal experiment was a split-split plot comprising sowing dates (27 Oct., 20 Nov., 17 Dec. at BT; 27 Nov., 17 Dec. at IK) and three N/K applications comprising basal N and K, and factorial N and K (medium and high rates for each nutrient). The maize experiment was a split plot design with dual sowing dates (27 Oct. and 27 Nov. at BT; 20 Oct. and 19 Nov. at IK) and three fertiliser levels (control, high inputs and demand). Brassica trials were factorial designs comprising location (x2), sowing date (x2) and cultivar. N and K balances were calculated for respective treatments in cereal and maize experiments allowing for plant uptake, pre- and post-season soils levels, and fertiliser application. Crops were managed for optimal biomass production within the constraints of the experimental treatments. Climatic risk analysis was performed for maize using a simulation model (Wilson *et al*. 1995) to predict forage yield, maturation time and harvest index (HI) using daily maximum/minimum temperature and solar radiation for Reefton (inland), Westport (northern coastal) and Hokitika (southern coastal).

Results Cereal yields were 7.6-13.0 t/ha. Fertiliser treatment and site effects accounted for most variation. Monthly delay in sowing caused yield losses of 1 t/ha. Medium fertility treatments achieved the best cereal yields. Maize yields were comparable with model predictions. Predicted crop failure was higher with later sowing, more northerly latitudes and distance from coast. (Table 1). By late March, turnips yielded up to 14 t/ha (8 t/ha in bulb) from 4 months growth. Total leaf yields of rape and cv. *Pasja* did not exceed 8 and 7 t/ha, respectively.

Table 1 Model predictions of risk of maize crop failure (percent of years tested). Crops failed if killed by frost before maturity, low yield (<14 t/ha) or incomplete grain fill (HI <0.4)

Sowing date	Reefton (23 years)	Westport (12 years)	Hokitika (21 years)
1 Oct.	9	8	5
15 Oct.	4	8	5
1 Nov.	17	17	10
15 Nov.	39	17	38

Conclusions Sowing time and choice of crop type ensured forage supply as follows: standing crops of brassicas for grazing (February-April); cereal harvest from January-March for whole-crop silage; and maize harvest from March-April for silage. High rates of fertiliser caused excessive leaching losses of N and K in cereals and maize. Best yields required moderate rates of N and K in frequent applications. Factors that influenced productivity and quality most were: *Fusarium* head blight in triticale; incomplete grain filling in late-sown maize from lower than average temperature and radiation during January-March; and chewing insects on brassicas during establishment. Overuse of N and K fertiliser, with leaching into ground water, occurred only with high fertiliser rates. Risk of crop failure induced by low temperature and radiation shortfall was apparent only in maize. Adverse effects of high rainfall, causing crop lodging losses, occurred only in heavily fertilised cereals.

Reference

Wilson D.R., R.C. Muchow & C.J. Murgatroyd (1995). Model analysis of temperature and solar radiation limitations to maize potential production in a cool climate. *Field Crops Research,* 43, 1-18.