Tiller Weight versus Tiller Number in a Perennial Ryegrass Population: A Productivity Index

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The 21st International Grassland Congress / 8th International Rangeland Congress took place in Hohhot, China from June 29 through July 5, 2008.

Proceedings edited by Organizing Committee of 2008 IGC/IRC Conference

Published by Guangdong People's Publishing House

Tiller weight versus tiller number in a perennial ryegrass population : a productivity index

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Key words : plant dry weight , productivity index , size-density compensation

Introduction In defining agronomic indicators of sward status , tiller population density is often intuitively linked with sward vigour and presumed to be indicative of productivity potential . However , grass swards are subject to tiller size-density compensation and exhibit considerable plasticity , with shoot size and density subject to genetic variation , and varying with factors such as change in grazing height or seasonal light influx . A productivity index (PI) representing combinations of tiller size and density predicted to result in higher (or lower) sward leaf area index (LAI) and DM productivity (Matthew *et al* ., 1995) has been shown to be useful when comparing genetically similar swards under differing managements , but it is known that the cultivar Grasslands Ruanui has an anomalously high PI when compared with Grasslands Ellett (Bahmani *et al* .,1997) . Here we report further investigation into factors affecting PI .

Materials and methods 3 clonal replicates of each of 200 full sib F_1 seedlings of a Grasslands Impact x Grasslands Samson cross were cultivated in 10cm diameter plastic bags in a glasshouse at AgResearch Palmerston North from April to July 2003 . Once established , plants were monitored for 4 leaf appearance intervals to determine leaf length (LL) , leaf appearance interval (A_L) , leaf elongation duration and (LED) , tiller number per plant (TN) , and plant dry weight (DW) . Plant spacing was such that the canopy approximated a closed field sward . For measurement units , see Table 1 . Leaf elongation rate (LER) , tiller weight (TW) , and PI (here : $\log_{10}$ TW + 1 .5 $\log_{10}$ TN/pot area) were also calculated for each plant . Data were averaged for clonal replicates and the data matrix of 8 variables for 202 genotypes so obtained , subjected to principal component (PC) analysis (using the covariance matrix) in Minitab version 10 .1 .

Results For each of the 200 genotypes and 2 parents , log (tiller weight , g) and log (tiller population density , m^{-2}) are plotted in Figure 1 . The solid line is an arbitrarily placed 1 :1 compensation line indicating combinations of tiller weight and density giving constant plant DW . The dashed line indicates constant PI (Matthew *et al* ., 1995) . The first 3 PCs (Table 1) accounted for 83% of the data variation . PC1 links high PI , DW and TN with lower LER and long LED . PCs 2 and 3 focus on change in DW and PI associated with TW and TN , respectively , and in both cases linked to high LER .

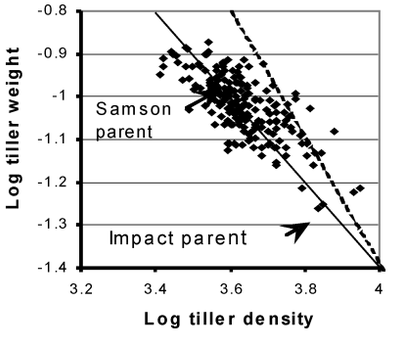

Figure 1 *Tiller size-density compensation within the Samson-Impact F1 population .*

Table 1 *Variable means and principal component (PC) structure for PCA exploring inter-relationships with Productivity Index (PI) . Coefficients less than 0 .2 are suppressed .*

	Mean	PC1	PC2	PC3
LL (mm)	176	-	0 .546	-0 .219
AL (days)	13 .3	0 .357	-	-0 .528
LED (days)	15 .1	0 .341	-	-0 .557
LER (mm day^{-1})	11 .9	-0 .347	0 .404	0 .229
DW (g $plant^{-1}$)	3 .2	0 .300	0 .482	0 .270
PI	4 .4	0 .444	0 .304	0 .338
TW (g)	0 .097	-0 .303	0 .428	-
TN (tillers $plant^{-1}$)	35	0 .493	-	0 .320
% variance explained	-	36 .9	26 .9	22 .8

Discussion and conclusions Means in Table 1 allow the reader to visualise the plant status during the experiment . As is common in PCA , the structure of PCs changed somewhat , depending on the variables entered into the analysis , but relationships between variables common to most PCA formulations were identified even so . PC1 has a strong size/density compensation component with small-tillered plants having high PI , a phenomenon also noted by Bahmani et al . 1997 . PC2 picks out genotypes with an association between LL , LER , DW , and PI , and follow-up study may be of interest to see if scores for this PC provide useful information for plant improvement .

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