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Summer-growing perennial grasses are a potential new feed source in the low rainfall environment of southern Australia

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Table 1: Values of the parameters used in the simulations of C4 perennial grass

Parameters marked with * have been added since the GRAZPLAN pasture model was originally published by Moore *et al.* (1997); parameters marked with † have changed their name or meaning. Optional parameters that are not used in this parameter set have not been listed.

Parameter	Units	Meaning	Value
grass		TRUE for grasses	TRUE
legume		TRUE for legumes	FALSE
annual		TRUE for annuals, FALSE for perennials	FALSE
isc4		TRUE if the species has the C_4 photosynthetic pathway	TRUE
longday		TRUE if long days required to induce reproductive growth	FALSE
K_{V3j}	°C	Base temperature for degree-day computations	10
K_{V5j}	°d	Degree-day sum for commencement of reproductive growth	800
K_{V6j}	°d	Degree-day sum for commencement of flowering	300
K_{V9j}	°d	Degree-day sum beyond which the reproductive phenostage can end	1500
K_{V10j}	0-1	Value of the soil moisture growth-limiting factor that defines "drought" for the senescence calculations	0.25
K_{V15j} *	0-1	Reduction in the rate of development due to water stress in pre-flowering, reproductive plants	0.0
K_{V16j} *	°C	Temperature threshold for the onset of winter dormancy	19
K_{V17j} *	hr	Threshold day length to end of winter dormancy at T_{lag}=0.0	11.5
K_{V18j} *	hr/ºC	Reduction in threshold day length to end winter dormancy	0.0
K_{V20j} *	d	Length of the drought period required to end reproductive growth when DD(j)= K_{V9j}	5.0
K_{V21j} *	°d	Value of DD(j) at which senescence occurs in the absence of drought	2000
K_{I1j}	m²/g	Reference specific leaf area (ratio of leaf area index to leaf weight)	0.030
K_{I2j} *	m²/g	Reference specific stem area	0.005
K_{I3j} *	MJ/m²/d	Curvature factor for effect of light on specific area	13.5
K_{I4j} *	°C	Temperature threshold for maximal specific area	15.0
K_{I5j} *	0-1	Relative specific area at 0ºC	0.60
K_{I6j} *	-	Relative decrease in specific leaf area at twice reference [CO_2]	0.18
K_{I7j} †	0-1	Apparent light extinction coefficient under ungrazed conditions	0.55
K_{I8j} †	0-1	Apparent extinction coefficient under heavily grazed conditions	0.80
K_{RU1j} †	g/MJ	Radiation use efficiency for gross assimilation under reference conditions	3.50
K_{RU2j} †	MJ/m²/hr	Effect of radiation intensity on radiation use efficiency (formerly K_{I4j})	99.9
K_{RU3j} *	0-1	Relative photosynthetic efficiency of stems	0.30
K_{RU4j} *	ppm	CO2 compensation point at 0°C	0.0
K_{RU5j} *	ppm	CO2 compensation point at 20°C	0.0
K_{RU6j} *	°C	Maximum temperature for CO2 compensation function	45.0
K_{BT1j} *	kPa g kg-1	Biomass-transpiration coefficient	16.0
K_{T1j} †	°C	Temperature for 5% of maximum gross assimilation rate	15.0
K_{T2j} †	°C	Temperature for 95% of maximum gross assimilation rate	25.0
K_{W1j} †	0-1	Transpiration ratio below which assimilation rate decreases	0.30
K_{WL1j} †	0-1	WFPS threshold for waterlogging	0.85
K_{WL2j} †	-	Curvature of growth limitation by waterlogging	23.0

Parameter	Units	Meaning	Value	
K_{MR1j} †	/d	Maximum relative growth rate of shoots during dormancy (formerly K_{A5j})	1.0	
K_{U1j}	-	Threshold growth-limiting factor for translocation from belowground reserves	0.40	
K_{U2j}	/d	Relative rate of translocation from belowground reserves	0.02	
K_{RE1j} *	g/g/d	Maintenance respiration rate at 10ºC (g DM/g N/d)	0.4	
K_{RE2j} *	-	Q10 factor for maintenance respiration	1.75	
K_{RE3j} *	0-1	Reduction in maintenance respiration in summer- or winter-dormant plants	0.0	
K_{RE4j} *	g/g	Growth respiration rate	0.25	
K_{A1j}	-	Target root:shoot ratio during vegetative growth	0.5	
K_{A2j}	-	Target root:shoot ratio during reproductive growth	0.3	
K_{A4j}	0-1	Maximum value of the ratio (leaf allocation):(shoot allocation)	0.6	
K_{A5j} *	0-1	Minimum value of the ratio (leaf allocation):(shoot allocation)	0.6	
K_{MO1j} *	-	Parameter governing height distribution of leaves	0.0	
K_{R1j} *	mm	Maximum rooting depth under optimal soil conditions	1200	
K_{R2j} *	mm/°d	Maximum rate of root front extension	2.0	
K_{R3j} *	°C	Base temperature for root front extension	0.0	
K_{R4j} *	0-1	ASW below which root extension is reduced	0.25	
K_{R5j} *	Mg/m³	Threshold bulk density for reduced root extension in 100% sand	1.40	
K_{R6j} *	Mg/m³	Threshold bulk density for reduced root extension in 0% sand	1.20	
K_{R7j} *	m³/Mg	Rate of decrease in root extension with increasing bulk density	2.0	
K_{R8j} *	0-1	Minimum value of the bulk density effect on root extension	0.10	
K_{R9j} *	m/g	Specific root length	115.0	
K_{R10j} *	m	Average radius of effective roots	0.00016	
K_{D1j} *	ºd	Thermal age at which death of shoots commences	800.0	
K_{D2j} *	/ºd	Background death rate of old shoots in seedlings & established plants	0.0030	
K_{D3j} *	/ºd	Additional death rate of all shoots in senescing plants	0.0	
K_{D4j} †	ºC	Temperature for 5% mortality at the first frost (formerly K_{D2j})	0.0	
K_{D5j} †	ºC	Temperature for 95% mortality at the first frost (formerly K_{D3j})	-5.0	
K_{D6j} †	ºC	Frost-hardening factor (formerly K_{D4j})	0.0	
K_{DR2j} *	/d	Specific root loss rate at 10ºC	0.0020	
$K_{F1,leaf,j}$ †	/d	Fall of standing dead: reference rate for leaf	0.0050	
$K_{F1,stem,j}$ †	/d	Fall of standing dead: reference rate for stem	0.0020	
K_{F2j} †	-	Fall of standing dead: maximum relative effect of precipitation	40.0	
K_{F3j} †	/mm	Fall of standing dead: curvature of precipitation effect	10.0	
K_{F4j} †	/kg animal/d	Fall of standing dead: trampling effect	30.0	
			Leaf	Stem
K_{Q1pj} *	g/g	Average digestibility of newly-produced herbage	0.80	0.75
K_{Q2pj} *	g/g	Minimum digestibility of green herbage during vegetative growth	0.60	0.55
K_{Q3pj} *	g/g	Minimum digestibility of green herbage during reproductive growth	0.55	0.35
K_{Q4j} *	ºd	Thermal time during which green leaf maintains its digestibility	100.0	
K_{Q5pj} *	/ºd	Rate parameter for decline of DMD of green herbage	0.008	0.004
K_{Q6j} *	ºC	Base temperature for maturation & senescence of green tissue	4.0	

Parameter	Units	Meaning	Value		
K_{Y1j} *	/d	Reference rate of microbial decomposition of digestible DM	0.020		
K_{Y2j} *	-	Factor for temperature response of decomposition	4.7		
K_{Y3j} *	ºC	Factor for temperature response of decomposition	32		
K_{Y4j} *	-	Minimum value of the moisture factor for standing dead	0.05		
K_{Y5j} *	g/g	Maximum moisture content of standing dead	7		
K_{Y6j} *	-	ASW for 5% of maximum decomposition	-0.2		
K_{Y7j} *	-	ASW for 95% of maximum decomposition	0.85		
K_{Y8j} *	0-1	Relative rate of decomposition of indigestible DM	0.10		
K_{Y9j} *	g/m^2	Critical mass for "thatch" effect on litter decay			
			Leaf	Stem	
K_{BR1pj} *	/d	Background rate of breakdown of litter	0.10	0.02	
K_{BR2j} *	/kg animal/d	Litter breakdown: trampling effect	10		
K_{BR3j} *	/d	Rate of litter incorporation under dry soil conditions	0.02		
K_{BR4j} *	/d	Rate of litter incorporation under wet soil conditions	0.05		
K_{BR5j} *	g/m^2	Critical mass for "thatch" effect on comminution	200.0		
			Leaf	Stem	Root
$K_{NU1,Npj}$ *	g/g	Maximum content of N in live biomass	0.040	0.020	0.015
$K_{NU2,Npj}$ *	g/g	Minimum content of N in live biomass (at maximum DMD for leaf and stem)	0.030	0.0075	0.010
$K_{NU3,Npj}$ *	g/g	Minimum content of N in live herbage at midpoint DMD	0.020	0.005	
$K_{NU4,Npj}$ *	g/g	Minimum content of N in green herbage at minimum DMD	0.015	0.003	
$K_{NU5,leaf,j}$ *	-	Relative decrease in leaf N content (per unit leaf area) at twice reference [CO_2]	0.1		
K_{NU5pj} *	-	Relative decrease in N content (per unit mass) at twice reference [CO_2]		0.0	0.0
$K_{UE1,NO3,j}$ *	-	Uptake effectiveness parameter for nitrate	1.0		
$K_{UE1,NH4,j}$ *	-	Uptake effectiveness parameter for ammonium	1.0		
K_{RL1Nj} *	/d	Relocation rate parameter for N	0.33		
K_{DGcj}	g/g	Degradability of protein in of herbage in each digestibility class *c*	*DMD* + 0.01		
K_{HRj}	-	Relative height:mass ratio (“height factor”)	7.0		
K_{SFj}	-	Parameter controlling the relationship between DMD and relative quality	0.0		