6. Appendix

6.1. User-modifiable Parameters Describing Crop Growth and Development

Parameter	Default value	Reference
Potential number of kernels per ear (G2). The default value is for high yielding maize hybrids in the U.S. Corn Belt	675 kernels ear^{-1}	Mean of maize cultivars in Nebraska, Iowa, Illinois and Indiana, Jones and Kiniry (1986)
Potential kernel filling rate (G5). The default value is for high yielding maize hybrids in the U.S. Corn Belt	8.7 mg $kernel^{-1}$ d^{-1}	Mean of maize cultivars in Nebraska, Iowa, Illinois and Indiana, Jones and Kiniry (1986)
Light extinction coefficient (k). The default value is for modern maize hybrids.	0.55	Lizaso et al. (2003b), Maddonni et al. (2001), and Yang et al. (2004).
Fraction of leaf mass that can be translocated to grain per day if leaf mass remains above minimum.	0.005 d^{-1}	Jones and Kiniry (1986)
Minimum fraction of leaf mass below which no translocation of carbohydrate from leaf to grain is allowed.	0.85	Jones and Kiniry (1986)
Growth respiration coefficient of leaf	0.47 g CH_2O g^{-1} dry matter	Kropff and van Laar (1993)
Growth respiration coefficient of stem	0.52 g CH_2O g^{-1} dry matter	Kropff and van Laar (1993)
Growth respiration coefficient of root	0.45 g CH_2O g^{-1} dry matter	Kropff and van Laar (1993)
Growth respiration coefficient of grain	0.49 g CH_2O g^{-1} dry matter	Kropff and van Laar (1993)
Maintenance respiration coefficient for leaf	0.01 g CH_2O g^{-1} dry matter d^{-1}	Through calibration of data collected in Nebraska
Maintenance respiration coefficient for stem	0.006 g CH_2O g^{-1} dry matter d^{-1}	Through calibration of data collected in Nebraska
Maintenance respiration coefficient for root	0.005 g CH_2O g^{-1} dry matter d^{-1}	Through calibration of data collected in Nebraska
Maintenance respiration coefficient for grain	0.005 g CH_2O g^{-1} dry matter d^{-1}	Through calibration of data collected in Nebraska

Parameter	Default value	Reference
Efficiency of carbohydrate translocation	0.26	Kiniry et al. (1992)
Daily root death rate in fraction	0.005	Jones and Kiniry (1986)
Stay-green coefficient in Eq. (10)	4	Yang et al. (2004)
Fraction of dead leaf at maturity in maximum LAI achieved at silking	0.7	Yang et al. (2004)
Upper effective temperature for GDD accumulation	34 ^oC	Jones and Kiniry (1986)
Maximum (photosynthetic) assimilation rate at plateau (A_{max})	7.0 g CO_2 m^{-2} leaf hr^{-1}	Kropff and van Laar (1993)
Minimum temperature for assimilation	8 ^oC	Kropff and van Laar (1993)
Starting temperature for maximum assimilation	18 ^oC	Kropff and van Laar (1993)
Ending temperature for maximum assimilation	30 ^oC	Kropff and van Laar (1993)
Initial light use efficiency	12.5 g CO_2 MJ^{-1} PAR	Kropff and van Laar (1993)
Upper effective temperature for maintenance respiration	30 ^oC	Kropff and van Laar (1993)
LAI above which stress due to light competition occurs	4	Jones and Kiniry (1986)
Biomass partitioning coefficient for root at emergence	0.35	Kropff and van Laar (1993)
Development stage (scale from 0 to 2 with silking as 1) when root growth stops	1.15	Kropff and van Laar (1993)
Offset for calculating $GDD_{silking}$ from GDD_{total}	-50	Yang et al. (2004)

6.2. Default Soil Physical Properties for Different Soil Texture Classes

Texture	Porosity	GAM cm^{-2}	PSI_{max} cm	K_{sat} $cm\ d^{-1}$	alfa cm^{-1}	AK $cm^{-2.4}\ d^{-1}$
loamy sand	0.44	0.033	200	26.5	0.0398	16.4
silt loam	0.51	0.185	300	6.5	0.02	47.3
loam	0.50	0.018	300	5.0	0.0231	14.4
sandy clay loam	0.43	0.0096	200	23.5	0.0353	33.6
silty clay loam	0.45	0.0105	300	1.5	0.0237	36.0
clay loam	0.45	0.0058	300	0.98	0.0248	1.69
light clay	0.51	0.0085	300	3.5	0.0274	2.77
silty clay	0.51	0.0065	50	1.3	0.048	28.2
heavy clay	0.54	0.0042	80	0.22	0.038	4.86

Adapted from Driessen and Konijn (1992).

6.3. Simulation of Major Growth and Development Processes in Different Models

Processes	CERES-Maize	INTERCOM	Hybrid-Maize
Photosynthesis computation	Constant RUE used to directly convert absorbed PAR into DM, adjusted for T; daily time-step for PAR interception without regard to solar angle.	Total intercepted PAR is split into direct and diffuse parts; solar angle considered; integrated over LAI distribution; adjusted for T.	Simplified version of INTERCOM routine, but without splitting total intercepted PAR into direct and diffuse parts and intra-day changes in solar angle.
Maintenance respiration	Not simulated but implicitly 'discounted' in the constant RUE value.	Based on live biomass and coefficients of 0.03, 0.015, 0.01 & 0.01 g CH_2O respired per g DM per day for leaf, stem, root & grain respectively, at 25°C; Q_{10} of 2.	Similar to INTERCOM, but with lower coefficients: 0.011, 0.006, 0.006 & 0.005 g CH_2O per g DM per day for leaf, stem, root and grain, respectively.
Leaf area expansion and senescence	Driven by T as a function of leaf number and assimilate availability; senescence driven by T.	Driven by assimilate availability, DM partitioning coefficients, and SLA; partitioning coefficients change with growth stage; senescence driven by T.	Similar to CERES-Maize until silking with SLA limited to ≤ 400 $cm^2\ g^{-1}$; leaf senescence after silking modified.
DM accumulation	Driven by T as a function of phenology, limited by assimilate availability; excess assimilate partitioned to roots.	Driven by assimilate supply and regulated by DM partitioning to all organs; partitioning coefficients change with growth stage.	Similar to CERES-Maize but with modification in dry matter partitioning to root; SLA limited to ≤ 400 $cm^2\ g^{-1}$.
Date of silking	Input parameter, hybrid specific.	Input parameter, hybrid specific.	Either as input parameter or estimated by: $GDD_{silking}$ =100+0.4451GDD_{total} -50
Cob growth	Driven by T as a fixed proportion of daily assimilation from silking until GDD=170 after silking.	Simulates mass of whole reproductive organ, including seed and cob.	Similar to CERES-Maize but DM partitioning to cob reduced by 60%.
Grain filling and translocation	Filling rate driven by T, assimilate supply and potential filling rate; potential filling rate is hybrid specific; limited translocation from stem and leaf reserves occurs when source < sink with a translocation efficiency of 26%.	Filling driven by assimilate supply; amount of translocated assimilate is a fixed proportion of 'live' DM loss from stem and leaf senescence.	Translocation and grain filling similar to CERES-Maize, actual grain filling rate is adjusted by plant density.

Abbreviations: RUE = radiation use efficiency; DM = dry matter; T = temperature; PAR = photosynthetically active radiation; LAI = leaf area index; SLA = specific leaf area; GDD = growing degree days; $GDD_{silking}$ = GDD from emergence to silking; GDD_{total} = GDD from emergence to maturity.