

Updates to 3PGJS versions 2.5 to 2.7

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Peter Sands, 39 Oakleigh Av, Taroona, Australia 7053
PeterSands@netspace.net.au

Version 2.5 of 3PGJS sees only minor changes to the 3-PG model itself. Major changes focus on the 3PGJS interface:

- The manner in which site-specific data and stand initialisation data can be input for multi-site runs has been radically generalised
- Multi-site runs can make site-specific changes to parameter values
- Multi-site runs can now use actual annual weather data.
- The list of output variables selected by the **Output data** keyword, and the list of output ages selected by the **Output dates** keywords can be specified as a comma-delimited list in a single cell to the right of the keyword.

Version 2.6 provides changes to the interface, including the addition of a set of useful chart tools to the 3PGJS menu, and enhancements to 3-PG:

- Two changes have been made in 3-PG in this release: conductance can have a non-zero value when LAI is zero or small, and modifiers have been introduced for atmospheric CO₂.
- Minor changes made to the menu system, removed the nag screen/disclaimer.
- 3PGjs workbooks no longer try to auto-load the 3-PG add-in: 3PGJS workbooks no longer include code in their **ThisWorkbook** module to automatically load or browse for the 3PGjs.xla add-in. Use the Excel Tools|Add-Ins menu to load and unload the add-in.
- A suite of charting tools have been added to the menu system

Version 2.7 fixes a bug in canopy conductance in vsn 2.6, and removed the hot keys.

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1. Updates to the 3-PG model in 3PGPJS vsn 2.5

The following minor changes to the 3-PG implementation have been made:

- If a time-scale parameter in one of the age varying factors is zero, it is assumed that the factor is constant at its value for mature stands.

For example, if $t_{\gamma N} = 0$, then $\gamma_N(t) = \gamma_{N1}$ for all t .

- To switch off the age modifier in canopy conductance, set **nAge** = 0.
- If transpiration is so high that it reduces available soil water (θ_s) to less than 0, transpiration is scaled so that θ_s is reduced to precisely 0 and NPP is then scaled (reduced) by the same factor.

2. Updates to the 3PGPJS interface in vsn 2.5.

2.1 Specification of dates of planting and stand initialisation

The planting date can be specified either by giving the year and month separately through the keywords **Year planted** and **Month planted**, or jointly through the new keyword **Date planted** using the **y&m** date format, e.g. the strings “1996y 5m” or “1996/5” both signify May 1996.

Similarly, the timing of stand initialisation can be specified either by giving the year and month at which the initial data is provided separately through the keywords **Initial year** and **Initial month**, or jointly through the new keyword **Initial date** using either of the above date formats. Alternatively, initialisation age can be given by using the **Initial age** keyword to specify the age of the stand (measured from the date of planting) in date format, e.g. “2y 3m” or “2/3” both indicate a stand age of 2 years and 3 months.

These keywords apply to single-site runs, and where appropriate to multi-site runs.

2.2 Specification of output names and ages

A list of output variable names for a run can now be specified as a comma delimited list in the single cell to the right of the **Output data** keyword. Similarly, a list of output ages can now be given as a comma delimited list of ages in either of the above date formats in the single cell to the right of the **Output ages** keyword.

The use of comma delimited lists for the variable names or age lists is now the preferred format.

Examples are

Output names	SLA, NPP, gammaF	
Output ages	4y 0m, 6y 3m, 10y 6m	

Note that the above list of ages is equivalently 4/0, 6/3, 10/6.

2.3 General site-specific inputs in multi-site runs

A major generalisation of the way in which multi-site runs can be specified has been implemented to provide considerable flexibility. All my old multi-site sheets work exactly as they did before. But, if you find yours do not, please email them to me and I'll see what I can do to maintain and restore backwards compatibility.

Multi-site input is specified by keywords appearing in two distinct regions: the *site-specific input/output area* as defined by the *header row*, and the *general sheet area*. Table 1 summarises all

keywords used in multi-site runs and appearing in these regions. The definitions and use of these regions are as follows

- The *header row* is identified by the keyword **Sites** in column A, and includes header-row keywords in contiguous cells to its right and the names of parameters to be changed for each site. The header row identifies columns of site-specific data, comprising site factors, stand initiation data, site-specific output ages, site-specific parameter changes, etc. Reading of header-row keywords is terminated by a blank cell or a cell that does not contain a valid keyword.
- If site-specific parameter changes are made, these parameter names must be to the right of all header-row keywords.
- Basic output for each site is written by 3PGPJS in columns immediately to the right of the regions defined by the header row and the list of site names in column A.
- The *site-specific input/output area* is the contiguous area of the sheet comprising the range of cells defined by the header area and its associated block of data, and the output area to its right implied by the output variables listed by the **Output data** keyword.
- The *general sheet area* is that area of the sheet not encompassed by the site-specific input/output area. Data is supplied in the general sheet area through keywords, and applies to all sites, but is possibly modified on a site by site basis. For example, the keyword **Species** selects the species for all sites on that worksheet, and the keyword **Fertility** defines a fertility schedule that is used to modify the FR specified individually for each site.

- Note the following specific new features:

Species-specific parameters can be given site-specific values by including the names of the relevant parameters in the header row; e.g. see the sample multi-site sheets

If detailed site output is written to a separate output sheet (specified using the keyword **Details sheet** in the global sheet area), the header row keyword **Output ages** can be used to specify a comma-delimited list of output ages in date format. If this list is blank for a specific site, the details sheet will have output for that site at the standard output ages (i.e. monthly or annually).

The worksheets **Multisite (a)**, **Multisite (b)** and **Multisite (c)** in **3PGPJS.data.xls** illustrate various multi-site sheets, with the last being a very general example.

2.4 Specifying calendar years in row format climatic data bases

Row format climatic data bases can now specify the actual calendar year for each annual record the monthly data. If this is the case, the first item in the **Climate data** list must be **Year**, and the year must be in the first field (i.e. column B) of each record. However, the actual year may be left blank for any station, in which case the climatic data is treated as generic for that station.

If the year of observation is available, 3PGPJS will attempt to match the climatic data chosen from the data base with the actual calendar year of the run as inferred from the current stand age and the year and month of planting. Note the following:

- if years are available in the data base and none of these match the year in which stand data is initialised, the run for that site is abandoned
- if there is insufficient annual climatic data for that site to cover the entire rotation, data is recycled, starting with climatic data from the date of stand initiation
- if the year is blank in the climatic records for a site, all supplied data for that site is used, with the first record applied to the first year of the run, etc.

3. Updates to the 3-PG model in 3PGPJS vsn 2.5

The following enhancements to the 3-PG model have been made:

- Canopy conductance can now have a non-zero value, specified by the parameter **MinCond**, when LAI is small. This corrects a problem where evapotranspiration of an open canopy was low and hence failed to take into account possible soil evaporation.
- Growth modifiers have been introduced to account for the possible effects of atmospheric CO₂ on canopy quantum efficiency and conductance. These require two new parameters, **fAlpha700** and **fCg700**, which are the factors by which canopy quantum efficiency and canopy conductance are changed when atmospheric CO₂ is 700 ppm as compared to the default values at 350 ppm. The output variable names for the modifiers are **fAlpha** and **fCg**.
- Atmospheric CO₂ is required as a site factor

4. Updates to 3PGPJS in vsns 2.6, 2.7.

The following changes have been made to the interface:

- A new site input factor is required: this is the atmospheric CO₂, specified by the keywords **Atmospheric CO2**.
- The new parameters outlined above are required. It is necessary to replace existing **3PG_Parameters** sheets with the **3PGpjs26_Parameters** sheet.
- The nag screen/disclaimer has been removed.
- 3PGpjs workbooks no longer auto-load the 3-PG add-in, and no longer include code in their **ThisWorkbook** module. Use the Excel **Tools\Add-Ins** menu to do loads the add-in.
- A suite of charting tools have been added to the menu system. These allow one to delete all charts from a sheet, easily create a new chart or change the independent variable, and export a chart as a GIF file.
- Vsn 2.7 fixed a bug in the canopy conductance code introduced in vsn 2.6.

4.1 Chart tools sub menu

Several tools for working with charts are provided by the Chart tools menu item:

- **Delete all charts** deletes all charts on the active sheet.
- **Save chart as a GIF file** allows you to save the currently selected chart as a GIF file.
- **Select independent variable** allows the data used as the independent variable of the currently selected chart to be changed. Note: it is assumed that all series in the chart are of the same length and have the same independent variable. It won't work if series have different ranges for their x-data.
- **Create a new chart** is a "wizard" that guides a series of steps to create a new chart on the active sheet. Yes, this can be done using native Excel charting commands, but the wizard provides a degree of uniformity and control across all spreadsheets (see below for more details). Besides, it's easy to use!

These tools assume that the data to be plotted are in a table where variables are the columns, and data for each set of independent variables (cases) are the rows. Data in other formats must be handled using standard Excel charting techniques.

4.2 The Create a new chart wizard

This wizard works as follows:

1. The user is asked to select the cell containing the name of the independent variable. Press OK to select the cell and continue, or Cancel to abort.
2. Next, select the cell containing the first value to be plotted, and press OK (or Cancel to abort). Then select the last independent value to be plotted. These data are in the same column as the name of the independent variable.
3. Now select the cell containing a dependent variable name, and press OK. Repeat this until all variables to be plotted have been selected, and then press Cancel to terminate variable selection.
4. The last step is to select a range of cells on the sheet where the chart is to be located. These cells do not need to be blank as the chart does not erase any data or formula in those cells. Press OK to create the chart, or Cancel to abandon the chart

The chart can now be treated as any chart in Excel, i.e. have additional series added, formatted, etc. using traditional Excel chart tools.

Table1. Multi-site run keywords

Keyword	Comments, context and meaning	Mandatory or optional
<i>General sheet area keywords – provides data used for all sites</i>		
Species	Name of species	M
Climate data	Name of climate data base worksheet	O
Seedling mass	Seedling biomass (g). Causes stand to be initialised at planting	O
Stand mass	Initial stand mass (t ha^{-1}). Initial stand biomass is distributed according to biomass fractions. Ignored if seedling mass > 0.	O
WF fraction WS fraction WR fraction	These keywords specify the fractions of initial stand biomass that are in the foliage, stem and root pools	O
Date planted Year planted Month planted	These keywords specify the date the stand was planted: give either date in year & month format, or the calendar year and month separately	M/O see (a)
Initial date Initial age Initial year Initial month	These keywords specify the date at which initial stand data is supplied: give either date in year & month format, or the stand age in year and month format, or the calendar year and month separately	M/O see (a)
End age	Stand age (years) at which run ends	M/O see (a)
Output frequency	Specify output frequency: n =none, r =rotation, a =annual, m =monthly	O
Output data	Lists names of output variables, separated by commas	O
Details sheet	Name of worksheet to be used for detailed site output	O
Parameters	Locates parameter change block for changes common to all sites	O
<i>Header row keywords – provides data on a site-by-site basis</i>		
Sites	Identifies header row, must be in column A	M
FR	Site fertility rating (0-1)	M
CO2	Atmospheric CO ₂ concentration	O
max ASW min ASW	Maximum and minimum plant available soil water (mm)	M
Soil class	Soil classification: 1-4, or S, SL, CL or C, or 0 for no soil water limits, or ? for default	M
Data base Station	Worksheet containing climatic data base (which must be in row format) and the name of the record (station) to be used for this site	O
Date planted Year planted Month planted	These keywords specify the date the stand was planted: give either date in year & month format, or the calendar year and month separately	M/O see (b)
Initial date Initial age Initial year Initial month	These keywords specify the date at which initial stand data is supplied: give either date in year & month format, or the stand age in year and month format, or the calendar year and month separately	M/O see (b)
Initial WF Initial WS Initial WR Initial stocking Initial ASW	These keywords specify the initial stand data: foliage stem and root biomass, stocking, and available soil water. Initial available soil water is optional.	M
End age	Stand age (years) at which run ends	M/O see (b)

- a) These keywords and data are required if the stand is initialised by **Seedling mass** or **Stand mass** keywords in the global sheet area
- b) These keywords and data are NOT required if the stand is initialised by **Seedling mass** or **Stand mass** keywords in the global sheet area