Package 'Rquefts'

March 13, 2020

Type Package

Title Quantitative Evaluation of the Native Fertility of Tropical Soils

Version 1.0-7

Date 2020-03-12

LinkingTo Rcpp

SystemRequirements C++11

Imports meteor, methods, Rcpp (>= 0.12.4)

Description An implementation of the QUEFTS (Quantitative Evaluation of the Native Fertility of Tropical Soils) model. The model (1) estimates native nutrient (N, P, K) supply of soils from a few soil chemical properties; and (2) computes crop yield given that supply, fertilizer application and crop parameters. See Janssen et al. (1990) <doi:10.1016/0016-7061(90)90021-Z> for the technical details and Sattari et al. (2014) <doi:10.1016/j.fcr.2013.12.005> for a recent evaluation and improvements.

License GPL (>= 3)

BugReports https://github.com/cropmodels/Rquefts/issues

URL https://github.com/cropmodels/Rquefts/

NeedsCompilation yes

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Repository CRAN

Date/Publication 2020-03-13 05:10:02 UTC

R topics documented:

`Rquefts-package` *Quantitative Evaluation of the Native Fertility of Tropical Soils*

Description

This package provides a R interface to a C++ implementation of the QUEFTS model. QUEFTS (Quantitative Evaluation of the Native Fertility of Tropical Soils) model (1) estimates native nutrient (N, P, K) supply of soils from a few soil chemical properties; and (2) computes crop yield given that supply, fertilizer application and crop parameters. See Janssen et al. (1990) <doi:10.1016/0016-7061(90)90021-Z> for the technical details and Sattari et al. (2014) <doi:10.1016/j.fcr.2013.12.005> for a recent evaluation and improvements.

`Fertilizers` *Helper functions to go from fertilizers to nutrients*

Description

Computes the amount of nutrients given a rate of fertilizer.

Usage

```
fertilizers()
nutrientRates(supply, treatment)
```

Arguments

`supply`	data.frame with columns "N", "P", "K" expressed as percentage of the product (row)
`treatment`	amounts applied

Examples

```
# fertilizer product list
fert <- fertilizers()
# shortening some of the names for display
fert[,2] = substr(fert[,2], 1, 20)
# contents are expressed as a percentage.
fert

myferts <- fert[c(8,15), ]
nutrientRates(myferts, c(100,50))
```

nutSupply *Soil nutrients supply for QUEFTS model*

Description

nutSupply1 computes the base (unfertilized) soil supply of N, P and K according to Janssen et al. (1990), Table 2. For use with the QUEFTS model.

nutSupply2 is a modified version following Sattari et al. (2014). It has an additional variable "temperature", and P-total is required. Sattari et al suggest that, for soils that have not been fertilized with P, you can estimate P-total as 95 * P-Olsen. Emperically, using soilGrids, I found 55 * P-Olsen.

Usage

```
nutSupply1(pH, SOC, Kex, Polsen, Ptotal=NA)
nutSupply2(temp, pH, SOC, Kex, Polsen, Ptotal)
```

Arguments

temp	average growing season temperature (C)
pH	soil pH (H2O)
SOC	soil organic carbon (g/kg)
Kex	exchangeble K in the soil (mmol/kg)
Polsen	soil P measured with the P-Olsen method (mg/kg)
Ptotal	total soil P (mg/kg)

Value

Matrix with three columns: Nsup, Psup and Ksup. These are the potential supply of N, P and K of the unfertilized soil (kg/ha).

References

Janssen B.H., F.C.T. Guiking, D. van der Eijk, E.M.A. Smaling, J. Wolf and H. van Reuler, 1990. A system for the quantitative evaluation of the fertility of tropical soils (QUEFTS). Geoderma 46: 299-318

Sattari, S.Z., M.K. van Ittersum, A.F. Bouwman, A.L. Smit, and B.H. Janssen, 2014. Crop yield response to soil fertility and N, P, K inputs in different environments: Testing and improving the QUEFTS model. Field Crops Research 157: 35-46

Examples

```
s1 <- nutSupply1(6, c(23, 11, 35), 15, c(1.6, 2.6, 2.4))
s1
s2 <- nutSupply2(20, 6, c(23, 11, 35), 15, c(1.6, 2.6, 2.4), 225)
s2
```

quefts *QUEFTS model*

Description

Create a QUEFTS model, set parameters, and run it to compute nutrient requirements and nutrient limited yield.

A number of default crop parameter sets are provided, as well as one example soil. You need to provide attainable crop production (in this context that is the maximum production in the absence of nutrient limitation), or target dry-matter biomass for leaves, stems and the storage organ (e.g. grain, root or tuber). Some crops are grown for the stems/leaves, in which case there is no relevant storage organ (e.g. sugarcane, jute). production yield estimates can be obtained with a crop growth model.

For a cereal crop you can assume that 50

Usage

```
quefts(soil, crop, fert, biom)
quefts_soil()
quefts_fert()
quefts_crop(name="")
quefts_biom()
crop(x) <- value
soil(x) <- value
fert(x) <- value
biom(x) <- value
run(x, ...)
```

Arguments

soil	list with named soil parameters. See Details. An example is returned by `quefts_soil()`
crop	list with named crop parameters. See Details. An example is returned by `quefts_crop()`
fert	list with named fertilizer parameters (N, P and K). An example is returned by `quefts_fert()`
biom	list with named biomass and growing season length parameters. An example is returned by `quefts_biom()`
name	character. crop name
x	QueftsModel object
value	list with soil, crop, fertilizer, or biomass parameters as above
...	additional arguments. None implemented

Details

Input Parameters	Explanation
Soil	.
N_base_supply, P_base_supply, K_base_supply	Potential supply (kg/ha) of N, P and K of the (unfertilized) s
N_recovery, P_recovery, K_recovery	Fertilizer recovery, that is, the fraction of applied fertilizer th
UptakeAdjust	Two-column matrix to compute the fraction uptake from soi
Crop	.
_minVeg, _maxVeg, _minStore, _maxStore	minimum and maximum concentration of "_" (N, P, or K) in
Yzero	the maximum biomass of vegetative organs at zero yield of s
Nfix	the fraction of a crop's nitrogen uptake supplied by biologica
Management	.
N, P, K	N, P, and K fertilizer applied.
Crop yield	.
leaf_att, stem_att, store_att	Attainable (in the absence of nutrient limitation), or target cr
SeasonLength	Length of the growing season (days)
.	
.	

Output Variables	Explanation
N_actual_supply, P_actual_supply, K_actual_supply	nutrient uptake from soil (not fertilizer) (kg/ha)
leaf_lim, stem_lim, store_lim	nutrient limited biomass of leaves, stems, and storage organ
N_gap, P_gap, K_gap	fertilizer required to reach the specified biomass (kg/ha)

Value

vector with output variables as described in the Details

References

Janssen B.H., F.C.T. Guiking, D. van der Eijk, E.M.A. Smaling, J. Wolf and H. van Reuler, 1990. A system for the quantitative evaluation of the fertility of tropical soils (QUEFTS). Geoderma 46: 299-318

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Examples

```
# create a QUEFTS model
# 1. get parameters
soiltype <- quefts_soil()
barley <- quefts_crop("Barley")
fertilizer <- list(N=0, P=0, K=0)
att_yield <- list(leaf_att=2200, stem_att=2700, store_att=4800, SeasonLength=110)

# 2. create a model
q <- quefts(soiltype, barley, fertilizer, att_yield)
```

```
# 3. run the model
run(q)

# change some parameters
q$SeasonLength <- 162
q$leaf_att <- 2651
q$stem_att <- 5053
q$store_att <- 8208

q$N <- 100
q$P <- 50
q$K <- 50

run(q)


## note that Rquefts uses C++ reference classes.
## This means that if you copy a quefts model, you do not create a
## new instance of the model, but you point to the same one!
q <- quefts()
q["N"]
k <- q
k["N"] <- 150
k["N"]
# the value of q has also changed!
q["N"]

## different ways of subsetting / replacement
q <- quefts()
q$N
q$N <- 30
q["N"]
q["N"] <- 90
q["model", "N"]
q["model", "N"] <- 60
q$N

q$soil$N_recovery
q["soil$N_recovery"]
q["soil$N_recovery"] <- .6
q["soil", "N_recovery"]
q["soil", "N_recovery"] <- .4
q$soil$N_recovery
```

`QueftsModel-class` *QueftsModel class*

Description

These are the classes!

Objects from the Class

QueftsModel$new()

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