Package ‘plantphysioR’

March 27, 2024

Title Fundamental Formulas for Plant Physiology

Version 1.0.0

Description Functions tailored for scientific and student communities involved in plant science research. Functionalities encompass estimation chlorophyll content according to Arnon (1949) <doi:10.1104/pp.24.1.1>, determination water potential of Polyethylene glycol(PEG)6000 as in Michel and Kaufmann (1973) <doi:10.1104/pp.51.5.914> and functions related to estimation of yield related indices like Abiotic tolerance index as given by Moosavi et al.(2008)<doi:10.22059/JDESERT.2008.27115>, Geometric mean productivity (GMP) by Fernandez (1992) <ISBN:92-9058-081-X>, Golden Mean by Moradi et al.(2012)<doi:10.14207/ejsd.2012.v1n3p543>, HAM by Schneider et al.(1997)<doi:10.2135/cropsci1997.0011183X003700010007x>,MPI and TOL by Hossain etal., (1990)<doi:10.2135/cropsci1990.0011183X003000030030x>, RDI by Fischer et al. (1979)<doi:10.1071/AR9791001>,SSI by Fisher et al.(1978)<doi:10.1071/AR9780897>, STI by Fernandez (1993)<doi:10.22001/wvc.72511>,YSI by Bouslama & Schapaugh (1984)<doi:10.2135/cropsci1984.0011183X002400050026x>, Yield index by Gavuzzi et al.(1997)<doi:10.4141/P96-130>.

License GPL (>= 3)

URL https://github.com/rameshram96/plantphysioR

BugReports https://github.com/rameshram96/plantphysioR/issues

Depends R (>= 2.10)

Suggests testthat (>= 3.0.0)

Config/testthat/edition 3

Encoding UTF-8

LazyData true

RoxygenNote 7.3.1

NeedsCompilation no

Author Ramesh Ramasamy [aut, cre] (<https://orcid.org/0000-0002-5433-1417>)

Maintainer Ramesh Ramasamy <ramesh.rahu96@gmail.com>

Repository CRAN

Date/Publication 2024-03-27 10:10:03 UTC

R topics documented:

`all_indices` *All indices combined*

Description

Function to all the indices related to biomass/ yield under different growth conditions

Usage

```
all_indices(Yp, Ys, Mp, Ms)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition
`Mp`	Mean yield of all the genotypes under control condition
`Ms`	Mean yiels of all the genotyps under Stress condition

Value

Indices Combined

Examples

```
Mp <- mean(yield_data$Yp)
Ms <- mean(yield_data$Ys)
Yp <- yield_data$Yp
Ys <- yield_data$Ys
all_indices(Yp, Ys, Mp, Ms)
```

`ATI` *Abiotic Tolerance Index (ATI)*

Description

Calculate abiotic tolerance index according to Moosavi et al. (2008)

Usage

```
ATI(Yp, Ys, Mp, Ms)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under Stress condition
`Mp`	Mean yield of all the genotypes under stress condition
`Ms`	Mean yield of all the genotypes under control condition

Value

ATI

References

Moosavi SS, Samadi YB, Naghavi MR, Zali AA, Dashti H, Pourshahbazi A (2008) Introduction of new indices to identify relative drought tolerance and resistance in wheat genotypes. Desert. 12: 165-178.

Examples

```
ATI(500, 350, 400, 300)
```

calculate_PEG_6000 *Calculate Polyethylene glycol (PEG) 6000 requirement*

Description

Calculate Amount of PEG6000 required to reach desired water potential at given temperature

Usage

```
calculate_PEG_6000(C, bar)
```

Arguments

C	Temperature of solution in degree centigrade
bar	Water potential in bars

Value

PEG6000 required

References

Michel, B. E., & Kaufmann, M. R. (1973). The osmotic potential of polyethylene glycol 6000. Plant physiology, 51(5), 914-916.

Examples

```
calculate_PEG_6000(25, -4)
```

caro_total *Total carotenoids content*

Description

Calculate total carotenoids using Method by Lichtenthaler (1987)

Usage

```
caro_total(A470, A663, A646, fresh_weight)
```

Arguments

A470	Absorbance at 470nm
A663	Absorbance at 663nm
A646	Absorbance at 646nm
fresh_weight	Fresh weight of the sample used in grams

Value

Carotenoids concentration in µg/ml

References

Lichtenthaler, H. K. (1987). Chlorophylls and carotenoids: pigments of photosynthetic biomembranes. In Methods in enzymology (Vol. 148, pp. 350-382). Academic Press.

Examples

```
caro_total(0.7, 0.041, 0.025, 1)
```

`chl_a` *Chlorophyll'a' Concentration by Arnon method*

Description

Calculates Chlorophyll a Concentration according to Arnon(1949) method

Usage

```
chl_a(A663, A645, v, w)
```

Arguments

`A663`	Absorbance at 663nm
`A645`	Absorbance at 645nm
`v`	Final volume of solvent used in ml
`w`	Fresh weight of the sample used in grams

Value

Chlorophyll a in mg/g of fresh weight

References

Arnon, D. I. (1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in Beta vulgaris. Plant physiology, 24(1), 1. doi:10.1104/pp.24.1.1

Examples

```
chl_a(0.025, 0.041, 15, 1)
```

`chl_b` *Chlorophyll b concentration*

Description

Calculates Chlorophyll b Concentration according to Arnon(1949) method

Usage

```
chl_b(A645, A663, v, w)
```

Arguments

A645	Absorbance at 645nm
A663	Absorbance at 663nm
v	Final volume of solvent used in ml
w	Fresh weight of the sample used in grams

Value

Chlorophyll b in mg/g of fresh weight

References

Arnon, D. I. (1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in Beta vulgaris. Plant physiology, 24(1), 1. doi:10.1104/pp.24.1.1

Examples

```
chl_b(0.041, 0.025, 15, 1)
```

`chl_total` *Total chlorophyll (a+b) concentration*

Description

Calculate Total chlorophyll (a+b) concentration using method by Arnon (1949)

Usage

```
chl_total(A645, A663, v, w)
```

Arguments

A645	Absorbance at 645nm
A663	Absorbance at 663nm
v	Final volume of solvent used in ml
w	Fresh weight of the sample used in grams

Value

Total chlorophyll (a+b) in mg/g of fresh weight

References

Arnon, D. I. (1949). Copper enzymes in isolated chloroplasts. Polyphenoloxidase in Beta vulgaris. Plant physiology, 24(1), 1. doi:10.1104/pp.24.1.1

Examples

```
chl_total(0.041, 0.025, 15, 1)
```

DRI *Drought resistant index (DRI)*

Description

The genotype with high values of this index will be more suitable for drought stress condition

Usage

```
DRI(Yp, Ys)
```

Arguments

Yp	Yield under control condition
Ys	Yield under stress condition

Value

DRI

Examples

```
DRI(500, 350)
```

gmp — *Geometric mean productivity (GMP) by Fernandez (1992)*

Description

The genotype with high values of this index will be more desirable

Usage

```
gmp(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

GMP

References

Fernandez, G. C. (1993). Effective selection criteria for assessing plant stress tolerance.

Examples

```
gmp(5, 3)
```

Golden_mean — *Golden Mean (GM)*

Description

Calculates Golden mean value using Moradi et al.,(2012)

Usage

```
Golden_mean(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

GM

References

Moradi H, Akbari GA, Khorasani SK, Ramshini HA (2012) Evaluation of drought tolerance in corn (Zea Mays L.) new hybrids with using stress tolerance indices. Eur J Sustain Dev 1. (3): 543-560

Examples

```
Golden_mean(500, 350)
```

`HAM` *Harmonic Mean*

Description

Harmonic Mean

Usage

```
HAM(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

Harmonic mean

References

Schneider, K. A., Rosales-Serna, R., Ibarra-Perez, F., Cazares-Enriquez, B., Acosta-Gallegos, J. A., Ramirez-Vallejo, P., ... & Kelly, J. D. (1997). Improving common bean performance under drought stress. Crop science, 37(1), 43-50.

Examples

```
HAM(500, 350)
```

`mp_index` *Mean productivity Index (MPI)- by Hossain et al., (1990)*

Description

The genotype with high values of this index will be more desirable

Usage

```
mp_index(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

Mean productivity Index

References

Hossain, A. B. S., Sears, R. G., Cox, T. S., & Paulsen, G. M. (1990). Desiccation tolerance and its relationship to assimilate partitioning in winter wheat. Crop Science, 30(3), 622-627.

`peg_6000` *Water potential of Polyethylene glycol (PEG) 6000*

Description

Calculate the corresponding water potential of PEG6000 when dissolved in 1l of water

Usage

```
peg_6000(peg, C)
```

Arguments

`peg`	Amount PEG600O in grams
`C`	Temperature of the solution in degree centigrade

Value

Water potential in bars

References

Michel, B. E., & Kaufmann, M. R. (1973). The osmotic potential of polyethylene glycol 6000. Plant physiology, 51(5), 914-916.

Examples

```
peg_6000(20, 25)
```

`R_drought_index` *Relative Drought Index (RDI)*

Description

Calculates relative drought index according to Fisher and Wood (1979)

Usage

```
R_drought_index(Yp, Ys, Mp, Ms)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition
`Mp`	Mean Yield of all the genotypes under control Condition
`Ms`	Mean Yield of all the genotypes under stress Condition

Value

RDI

References

Fischer RA, Wood JT (1979) Drought resistance in spring wheat cultivars III. Yield association with morphological traits. Aust J Agr Res. 30: 1001-1020

Examples

```
R_drought_index(500, 350, 400, 300)
```

ss_index — *Stress susceptibility index (SSI) by Fischer and Maurer (1978)*

Description

The genotype with high SSI < 1 are more resistant to drought stress conditions

Usage

```
ss_index(Yp, Ys, Ms, Mp)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under Stress condition
`Ms`	Mean yield of all the genotypes under control condition
`Mp`	Mean yield of all the genotypes under stress condition

Value

SSI

References

Fischer, R. A., & Maurer, R. (1978). Drought resistance in spring wheat cultivars. I. Grain yield responses. Australian Journal of Agricultural Research, 29(5), 897-912.

Examples

```
ss_index(500, 350, 450, 370)
```

st_index — *Calculate Stress tolerance index (STI) suggested by Fernandez (1992)*

Description

The genotype with high STI values will be tolerant to drought

Usage

```
st_index(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

STI

References

Fernandez, G. C. (1993). Effective selection criteria for assessing plant stress tolerance.

Examples

```
st_index(500, 350)
```

`tol_index` *Tolerance index -TOL by Hossain et al., (1990)*

Description

Higher the TOL value indicates the genotype is tolerant to stress

Usage

```
tol_index(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

TOL

References

Hossain, A. B. S., Sears, R. G., Cox, T. S., & Paulsen, G. M. (1990). Desiccation tolerance and its relationship to assimilate partitioning in winter wheat. Crop Science, 30(3), 622-627.

Examples

```
tol_index(500, 350)
```

yield_data *Example data*

Description

Yield data of rice in kg/ha under two different growth conditions

Usage

```
yield_data
```

Format

A data frame with 50 rows and 3 variables:

`Genotype` character Genotype

`Yp` integer Yield under control condition

`Ys` integer Yield under drought condition

Source

Simulated data, no external source were used

References

No external reference

yield_reduction *Yield Reduction*

Description

Claculate percent yield reduction over control

Usage

```
yield_reduction(Yp, Ys)
```

Arguments

`Yp`	Yield under control condition
`Ys`	Yield under stress condition

Value

YR

Examples

```
yield_reduction(500, 350)
```

`YR_ratio` *Yield reduction ratio (YR)*

Description

lesser the YR value more stable under stress conditions

Usage

```
YR_ratio(Yp, Ys)
```

Arguments

Yp	Yield under control condition
Ys	Yield under stress condition

Value

YR

Examples

```
YR_ratio(500, 350)
```

`YSI` *Yield reduction index or Yield Stability Index (YSI)*

Description

Higer YSI value depicts that particular genotype is stable under both normal and stressed conditions

Usage

```
YSI(Yp, Ys)
```

Arguments

Yp	Yield under control condition
Ys	Yield under stress condition

Value

YSI

References

Bouslama, M., & Schapaugh Jr, W. T. (1984). Stress tolerance in soybeans. I. Evaluation of three screening techniques for heat and drought tolerance 1. Crop science, 24(5), 933-937.

Examples

```
YSI(500, 350)
```

Y_index *Yield index (YI)*

Description

Yield index (YI)

Usage

```
Y_index(Ys, Ms)
```

Arguments

Ys	Yield under stress condition
Ms	Mean Yield of all the genotypes under stress Condition

Value

Yield Index

References

Gavuzzi, P., Rizza, F., Palumbo, M., Campanile, R. G., Ricciardi, G. L., & Borghi, B. (1997). Evaluation of field and laboratory predictors of drought and heat tolerance in winter cereals. Canadian journal of plant science, 77(4), 523-531.

Examples

```
Y_index(500, 300)
```

Index