

# The **viabilitymetrics** package: A brief introduction

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## Contents

Overview	1
Installation	1
Viability constants	1
Citing <b>viabilitymetrics</b>	6
Session Info	6
References	7

## Overview

The package **viabilitymetrics**.....



## Installation

The package can be installed using the following functions:

```
# Install from CRAN
install.packages('viabilitymetrics', dependencies=TRUE)

# Install development version from Github
devtools::install_github("aravind-j/viabilitymetrics")
```

Then the package can be loaded using the function

```
library(viabilitymetrics)
```

## Viability constants

Index	Species	K <sub>E</sub>	C <sub>W</sub>	C <sub>H</sub>	C <sub>Q</sub>	Reference
1	<i>Abelmoschus esculentus</i> *	6.659	2.448	0.0329	0.000478	Daniel et al. ( <a href="#">2013</a> )
2	<i>Acer platanoides</i> *	7.22	4.23	0.0329	0.000478	Dickie et al. ( <a href="#">1991</a> )
3	<i>Agastache rugosa</i>	6.93	4.255	0.0329	0.00048	Lee et al. ( <a href="#">2017</a> )
4	<i>Agathus australis</i>	6.36	3.64	0.0329	0.000478	Dickie and Smith ( <a href="#">1995</a> )
5	<i>Allium cepa</i>	6.975	3.47	0.04	0.000428	Ellis and Roberts ( <a href="#">1981</a> )
6	<i>Allium cepa</i> *	9.083	5.81	0.0329	0.000478	Ellis et al. ( <a href="#">1990</a> )
7	<i>Arabidopsis thaliana</i>	8.35	5.15	0.0563	8.39e-05	Hay et al. ( <a href="#">2003</a> )
8	<i>Arachis hypogaea</i>	6.718	4.089	0.0329	0.000478	Ellis et al. ( <a href="#">1990</a> )

Index	Species	K <sub>E</sub>	C <sub>W</sub>	C <sub>H</sub>	C <sub>Q</sub>	Reference
9	<i>Arachis hypogaea</i>	6.177	3.426	0.0304	0.000453	Usberti and Gomes (1998)
10	<i>Araucaria columnaris</i>	5.66	2.68	0.033	0.000478	Tompsett (1984); Tompsett (1992)
11	<i>Araucaria cunninghamii</i>	7.49	3.73	0.033	0.000478	Tompsett (1992)
12	<i>Balfourodendron riedelianum</i>	2.867	9.77e-13	1.344e-12	1.165e-13	Ignácio (2013)
13	<i>Beta vulgaris</i>	9.373	5.152	0.0372	0.000467	Ellis and Hong (2007)
14	<i>Beta vulgaris</i> *	8.943	4.723	0.0329	0.000478	Ellis et al. (1990)
15	<i>Borago officinalis</i>	6.748	2.42	0.0665	0.000478	Far et al. (2010)
16	<i>Brachiaria brizantha</i> (Intact seed)	6.488	4.48	0.0475	0.001292	Usberti (2007)
17	<i>Brachiaria brizantha</i> (Scarified seed)	8.795	4.852	0.02114	0.000733	Usberti (2007)
18	<i>Brassica juncea</i> *	7.768	4.56	0.0329	0.000478	Ellis et al. (1989)
19	<i>Brassica napus</i> *	7.718	4.54	0.0329	0.000478	Ellis et al. (1989)
20	<i>Brassica napus</i>	5.654	2.5	0.04387	1.438e-05	Alivand et al. (2013)
21	<i>Capsicum annum</i> *	7.767	4.67	0.0329	0.000478	Demir et al. (2009)
22	<i>Celosia argentea</i> *	4.957	1.188	0.0329	0.000478	Daniel et al. (2012)
23	<i>Chenopodium quinoa</i> *	8.58	5.02	0.0329	0.000478	Ellis et al. (1988)
24	<i>Cicer arietinum</i>	8.901	4.847	0.0329	0.000478	Ellis et al. (1982); Dickie et al. (1990)
25	<i>Cicer arietinum</i>	8.502	4.602	0.0295	0.000491	Ellis (1988)
26	<i>Citrullus lanatus</i> *	4.86	1.59	0.0329	0.000478	Demir et al. (2011)
27	<i>Cucumis melo</i> *	6.11	2.59	0.0329	0.000478	Demir et al. (2011)
28	<i>Cucumis melo</i>	7.299	3.707	0.0367	0.000473	Kuo (1991)
29	<i>Cucumis sativus</i> *	5.35	2.03	0.0329	0.000478	Demir et al. (2011)
30	<i>Cucurbita pepo</i>	6.913	3.604	0.04	4e-04	Hong et al. (1996)
31	<i>Cucurbita pepo</i> subsp. <i>pepo</i> convar. <i>pepo</i> var. <i>styriaca</i>	3.402	3.215	0.131	0.00264	Far et al. (2010)
32	<i>Dactylis glomerata</i>	4.715	0.554	0.03	2e-04	Reza (2014a)
33	<i>Dalbergia nigra</i>	5.199	4.524	0.08175	0.001641	Chaves and Usberti (2004)
34	<i>Delphinium ambiguum</i>	7.67	3.12	0.04	4e-04	Hong et al. (1996)
35	<i>Descurainia sophia</i>	4	0.179	0.03	0.000445	Reza (2014b)
36	<i>Digitalis purpurea</i> *	7.49	5.61	0.0329	0.000478	Hong et al. (1996)
37	<i>Dimorphandra mollis</i>	6.282	3.838	0.05405	0.001316	Chaves and Usberti (2004)
38	<i>Dioscorea dumetorum</i>	5.859	-3.06	-7e-04	-7e-04	Daniel et al. (2003)
39	<i>Dioscorea togoensis</i>	4.505	-1.646	-0.02	-0.00011	Daniel et al. (2003)
40	<i>Dipterocarpus alatus</i>	5.92	2.69	0.033	0.000478	Tompsett (1992)

Index	Species	K <sub>E</sub>	C <sub>W</sub>	C <sub>H</sub>	C <sub>Q</sub>	Reference
41	<i>Dipterocarpus intricatus</i>	6.18	2.77	0.033	0.000478	Tompsett (1992)
42	<i>Dracocephalum moldavica</i>	3.837	0.2	0.03	2e-04	Reza (2014b)
43	<i>Eleusine coracana</i>	7.88	4.181	0.0254	0.000489	Ellis and Hong (2007)
44	<i>Eleusine coracana</i> *	9.508	5.08	0.0329	0.000478	Ellis et al. (1989)
45	<i>Elytrigia elongate</i>	6	1.642	0.03	2e-04	Reza (2014a)
46	<i>Entandophragma angolense</i>	4.6	2.21	0.033	0.000478	Tompsett (1992)
47	<i>Eragrostis tef</i> *	10.1	6.01	0.0329	0.000478	Ellis et al. (1989)
48	<i>Eragrostis tef</i> cv. Muri	9.727	5.185	0.0329	0.00054	Zewdie and Ellis (1991)
49	<i>Eragrostis tef</i> cvs.	9.927	5.185	0.0329	0.00054	Zewdie and Ellis (1991)
50	<i>Eruca sativa</i>	4.33	0.4574	0.03	0.000304	Reza (2014b)
51	<i>Eucalyptus bussei</i> *	7.3	3.96	0.0329	0.000478	Muthoka et al. (2009)
52	<i>Eucalyptus erythrocorys</i>	8.81	4.97	0.0412	0.000379	Crawford et al. (2013)
53	<i>Eucalyptus grandis</i>	9.661	6.467	0.03498	0.000233	Fantinatti and Usberti (2007)
54	<i>Eucalyptus heterochroma</i> *	8.9	6.89	0.0329	0.000478	Muthoka et al. (2009)
55	<i>Eucalyptus heterophylla</i> *	7.4	4.36	0.0329	0.000478	Muthoka et al. (2009)
56	<i>Eucalyptus pseudoburuana</i> *	10.1	7.81	0.0329	0.000478	Muthoka et al. (2009)
57	<i>Eucalyptus quinquecostata</i> *	10.2	8.09	0.0329	0.000478	Muthoka et al. (2009)
58	<i>Festuca ovina</i>	4.366	0.5	0.03	2e-04	Reza (2014a)
59	<i>Glycine max</i>	7.525	4.086	0.0329	0.000478	Ellis et al. (1982); Dickie et al. (1990)
60	<i>Glycine max</i>	7.292	3.996	0.0295	0.000491	Ellis (1988)
61	<i>Gossypium hirsutum</i>	9.24	5.19	0.03965	0.000426	Usberti et al. (2006)
62	<i>Guizotia abyssinica</i> *	7.578	4.78	0.0329	0.000478	Ellis et al. (1989)
63	<i>Guizotia abyssinica</i>	7.494	4.257	0.0372	0.00048	Zewdie and Ellis (1991)
64	<i>Gypsophila elegans</i>	9.6	5.36	0.04	4e-04	Hong et al. (1996)
65	<i>Helianthus annuus</i> *	6.74	4.16	0.0329	0.000478	Ellis et al. (1988)
66	<i>Hordeum vulgare</i>	9.144	5.342	0.0329	0.000478	Ellis and Roberts (1980); Dickie et al. (1990)
67	<i>Khaya senegalensis</i>	4.76	2.15	0.033	0.000478	Tompsett (1992)
68	<i>Lactuca sativa</i>	7.938	5.25	0.0329	0.000478	Ellis et al. (1989)
69	<i>Lactuca sativa</i> *	6.895	4.2	0.0329	0.000478	Kraak and Vos (1987); Dickie et al. (1990)
70	<i>Lallemantia royleana</i>	4.725	2.324	0.02544	1.068e-05	Baladi and Balouchi (2016)
71	<i>Linum usitatissimum</i> *	7.76	4.86	0.0329	0.000478	Ellis et al. (1988)
72	<i>Linum usitatissimum</i> cv. Norman	5.201	2.59	0.03613	1.5e-05	Balouchi et al. (2017)

Index	Species	K <sub>E</sub>	C <sub>W</sub>	C <sub>H</sub>	C <sub>Q</sub>	Reference
73	<i>Linum usitatissimum</i> cv. Urmia	4.474	2.185	0.01467	0.000161	Balouchi et al. (2017)
74	<i>Liquidambar styraciflua</i>	6.553	3.033	0.0081	0.00151	Bonner (1994)
75	<i>Liquidambar styraciflua</i>	6.385	2.706	0.0306	0.000967	Bonner (1994)
76	<i>Lupinus polyphyllus</i>	6.217	2.761	0.04	4e-04	Dickie and Bowyer (1985)
77	<i>Lycopersicon esculentum</i>	6.502	3.181	0.0324	0.000431	Kruse et al. (2005)
78	<i>Lycopersicon esculentum</i>	4.544	2.683	-0.05018	0.001266	Sinício et al. (2009)
79	<i>Malus domestica</i>	7.316	4.119	0.04	0.00042	Dickie (1988)
80	<i>Melilotus officinalis</i>	4.21	0.2	0.03	2e-04	Reza (2014b)
81	<i>Nigella sativa</i>	4.97	1.253	0.0516	0.000478	Far et al. (2010)
82	<i>Orobanchae aegyptiaca</i>	6.434	0.0356	0.066	1e-05	Kebreab and Murdoch (1999)
83	<i>Orobanchae crenata</i>	6.447	0.0356	0.066	1e-05	Kebreab and Murdoch (1999)
84	<i>Orobanchae minor</i>	6.126	0.0356	0.066	1e-05	Kebreab and Murdoch (1999)
85	<i>Oryza glaberrima</i>	9.406	5.043	0.0375	0.000471	Ellis and Hong (2007)
86	<i>Oryza glaberrima</i> *	6.871	5.51	0.0329	0.000478	Bam et al. (2008)
87	<i>Oryza sativa</i>	8.242	4.345	0.0307	0.000501	Ellis and Hong (2007)
88	<i>Oryza sativa</i> *	8.668	5.03	0.0329	0.000478	Ellis et al. (1989)
89	<i>Oryza sativa</i> ssp. <i>indica</i> *	8.81	4.904	0.0329	0.000478	Ellis et al. (1992)
90	<i>Oryza sativa</i> ssp. <i>japonica</i> *	8.416	4.904	0.0329	0.000478	Ellis et al. (1992)
91	<i>Oryza sativa</i> ssp. <i>japonica</i> *	6.628	5.51	0.0329	0.000478	Bam et al. (2008)
92	<i>Oryza sativa</i> ssp. <i>javanica</i> *	8.736	4.904	0.0329	0.000478	Ellis et al. (1992)
93	<i>Papaver nudicaule</i>	6.838	4.101	0.027	0.000313	Belletti et al. (1991)
94	<i>Paspalum scrobiculatum</i>	8.066	4.449	0.0266	0.000526	Ellis and Hong (2007)
95	<i>Pennisetum glaucum</i> *	8.728	4.86	0.0329	0.000478	Ellis et al. (1989)
96	<i>Pennisetum purpureum</i> $\tilde{A}$ — <i>P. glaucum</i> (Cutting type)	7.735	4.658	0.01969	0.000403	Pozitano and Usberti (2009)
97	<i>Pennisetum purpureum</i> $\tilde{A}$ — <i>P. glaucum</i> (Grazing type)	8.825	4.522	0.03655	3e-04	Pozitano and Usberti (2009)
98	<i>Pennisetum purpureum</i> $\tilde{A}$ — <i>P. glaucum</i> (Original type)	8.417	5.037	0.02309	0.000436	Pozitano and Usberti (2009)
99	<i>Pennisetum typhoides</i>	8.442	5.035	0.025	0.000443	Ellis and Hong (2007)
100	<i>Phaseolus vulgaris</i> *	9.09	4.761	0.0329	0.000478	Ellis et al. (1990)
101	<i>Phaseolus vulgaris</i>	9.08	5.2	0.0057	0.00079	Wilson and McDonald (1989)

Index	Species	K <sub>E</sub>	C <sub>W</sub>	C <sub>H</sub>	C <sub>Q</sub>	Reference
102	<i>Phleum pratense</i>	9.571	5.262	0.04	4e-04	Hong et al. (1996)
103	<i>Phleum pratense</i> cv. Erecta*	8.678	4.75	0.0329	0.000478	Ellis et al. (1989)
104	<i>Phleum pratense</i> cv. S325*	8.138	4.75	0.0329	0.000478	Ellis et al. (1989)
105	<i>Pinus elliottii</i>	5.588	1.449	0.0326	0.00101	Bonner (1994)
106	<i>Pinus elliottii</i>	5.246	0.9832	0.0508	0.000571	Bonner (1994)
107	<i>Pinus occidentalis</i>	5.047	1.678	0.0206	0.00126	Bonner (1994)
108	<i>Pinus occidentalis</i>	5.101	1.674	0.0354	0.000838	Bonner (1994)
109	<i>Pinus taeda</i>	3.618	-0.2567	0.00064	0.00122	Bonner (1994)
110	<i>Pinus taeda</i>	3.278	-0.73	0.0348	0.000328	Bonner (1994)
111	<i>Pinus taeda</i>	8.838	5.981	0.1034	0.0005476	Fantinatti and Usberti (2007)
112	<i>Pisum sativum</i> *	9.858	5.39	0.0329	0.000478	Ellis et al. (1989)
113	<i>Pongamia pinnata</i>	5.75	3.26	0.04	3e-04	Kundu (2008)
114	<i>Ranunculus sceleratus</i>	6.98	5.01	0.0329	0.000428	Hong et al. (1996)
115	<i>Saccharum</i> spp.	8.805	5.168	5.168	0.000581	Ellis and Hong (2007)
116	<i>Salvia officinalis</i>	5	1.49	0.0329	2e-04	Reza (2014b)
117	<i>Satureja hortensis</i>	4.46	0.391	0.0329	0.000478	Reza (2014b)
118	<i>Secale cereale</i>	6.361	2.059	0.03	0.000201	Reza (2014a)
119	<i>Secale montanum</i>	4.431	0.472	0.03	0.000201	Reza (2014a)
120	<i>Secale montanum</i>	6.114	2.577	0.03856	0.00013	Dehghan and Sharif-Zadeh (2015)
121	<i>Sesamum indicum</i>	7.19	4.02	0.04	0.000428	Ellis et al. (1986)
122	<i>Setaria italica</i>	8.657	4.968	0.0304	0.000504	Ellis and Hong (2007)
123	<i>Setaria italica</i> *	8.678	4.95	0.0329	0.000478	Ellis et al. (1989)
124	<i>Solanum macrocarpon</i>	5.166	3.009	0.094	0.0019	Daniel et al. (2011)
125	<i>Solanum tuberosum</i>	7.923	5.063	0.0325	0.000432	Ellis and Hong (2007)
126	<i>Sorghum bicolor</i>	2.49	-0.3002	0.00725	-0.00057	Ali (2014)
127	<i>Sorghum bicolor</i>	9.472	5.426	0.0324	0.000478	Ellis and Hong (2007)
128	<i>Sorghum bicolor</i>	10.59	6.305	0.041	0.000349	Kuo et al. (1990)
129	<i>Sorghum bicolor</i>	2.49	-0.3002	0.00725	-0.00057	Tabatabaei (2014)
130	<i>Swietenia humilis</i>	5.393	2.391	0.0329	0.000478	Dickie et al. (1990)
131	<i>Tagetes patula</i>	12.22	3.114	0.2769	0.002212	Simões et al. (2008)
132	<i>Terminalia brassii</i>	5.016	2.161	0.0329	0.000478	Tompsett (1986); Tompsett (1992)
133	<i>Thymus daenensis</i>	5	0.753	0.0347	2e-04	Reza (2014b)
134	<i>Thymus transcaspicus</i>	5.065	0.0641	0.03	2e-04	Reza (2014b)
135	<i>Trifolium subterraneum</i>	7.21	3.51	0.04	4e-04	Hong et al. (1996)
136	<i>Triticum aestivum</i>	9.043	5.183	0.0351	0.000475	Ellis and Hong (2007)
137	<i>Triticum aestivum</i> *	9.42	5.859	0.0329	0.000478	Ellis et al. (1990)

Index	Species	$K_E$	$C_W$	$C_H$	$C_Q$	Reference
138	<i>Ulmus carpinifolia</i>	5.83	3.035	0.0329	0.000478	Tompsett (1986); Tompsett (1992)
139	<i>Vigna radiata</i> *	10.86	6.27	0.0329	0.000478	Ellis et al. (1989)
140	<i>Vigna unguiculata</i>	9.401	5.118	0.0329	0.000478	Ellis et al. (1982); Dickie et al. (1990)
141	<i>Vigna unguiculata</i>	9.102	4.967	0.0295	0.000491	Ellis (1988)
142	<i>Xanthorrhoea preissii</i>	8.77	5.29	0.0382	0.000472	Crawford et al. (2013)
143	<i>Zea mays</i>	10.56	6.366	0.0332	0.000577	Ellis and Hong (2007)
144	<i>Zea mays</i> *	8.579	4.91	0.0329	0.000478	Hong et al. (1996)

\* Viability constants are derived from storage experiment at a single temperature.  $C_H$  and  $C_Q$  here are the universal temperature coefficients (0.0329 and 0.000478 respectively).

## Citing viabilityMetrics

To cite the R package 'viabilityMetrics' in publications use:

J. Aravind, J. Radhamani, S. Vimala Devi, Sherry Rachel Jacob and Kalyani Srinivasan (2018). viabilityMetrics: Seed Viability Calculations and Curve Fitting. R package version 0.0.0.9000, <https://aravind-j.github.io/viabilityMetrics/>.

A BibTeX entry for LaTeX users is

```
@Manual{,
  title = {viabilityMetrics: Seed Viability Calculations and Curve Fitting},
  author = {{Aravind J} and {Vimala Devi S} and {Radhamani J} and {Sherry Rachel Jacob} and {Kalyani Srinivasan}},
  year = {2018},
  note = {R package version 0.0.0.9000},
  note = {https://aravind-j.github.io/viabilityMetrics/},
}
```

This free and open-source software implements academic research by the authors and co-workers. If you use it, please support the project by citing the package.

## Session Info

```
sessionInfo()
```

```
R version 3.5.1 (2018-07-02)
Platform: x86_64-w64-mingw32/x64 (64-bit)
Running under: Windows >= 8 x64 (build 9200)
```

```
Matrix products: default
```

```

locale:
[1] LC_COLLATE=English_India.1252 LC_CTYPE=English_India.1252
[3] LC_MONETARY=English_India.1252 LC_NUMERIC=C
[5] LC_TIME=English_India.1252

attached base packages:
[1] stats      graphics  grDevices  utils      datasets  methods    base

other attached packages:
[1] viabilitymetrics_0.0.0.9000

loaded via a namespace (and not attached):
[1] Rcpp_0.12.16      pillar_1.2.2      compiler_3.5.1
[4] plyr_1.8.4        tools_3.5.1       digest_0.6.15
[7] evaluate_0.10.1   memoise_1.1.0     tibble_1.4.2
[10] gtable_0.2.0      rlang_0.2.1       bibtex_0.4.2
[13] rstudioapi_0.7.0-9000 commonmark_1.5    yaml_2.1.19
[16] knitr_1.20        withr_2.1.2       stringr_1.3.0
[19] roxygen2_6.0.1    xml2_1.2.0        desc_1.2.0
[22] devtools_1.13.5   gbrd_0.4-11       rprojroot_1.3-2
[25] grid_3.5.1        data.table_1.11.4 R6_2.2.2
[28] Rdpack_0.7-0      rmarkdown_1.10    pander_0.6.1
[31] ggplot2_2.2.1     magrittr_1.5       scales_0.5.0
[34] backports_1.1.2   htmltools_0.3.6   assertthat_0.2.0
[37] colorspace_1.3-2  stringi_1.1.7     lazyeval_0.2.1
[40] munsell_0.4.3     crayon_1.3.4

```

## References

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