**Supplementary Material for:** **The Co-evolution of RuBisCO, Photorespiration and Carbon Concentrating Mechanisms in Higher Plants** (**Peter L. Cummins,** Department of Genome Sciences, John Curtin School of Medical Research, The Australian National University, Canberra ACT 0200, Australia.)

**Table S1.** Kinetic parameters *V* (s-1), *K* (M), *S* (s-1.mM-1) and *S*C/O for C3 species.

|  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** | ***V*C** | ***K*C** | ***S*C** | ***V*O** | ***K*O** | ***S*O** | ***S*C/O** |
| *Limonium antonii* | 2.4 | 8.7 | 276 | 0.976 | 397 | 2.46 | 112 |
| *Limonium artruchium* | 3 | 9.4 | 319 | 0.909 | 321 | 2.83 | 113 |
| *Limonium balearicum* | 3.6 | 9.7 | 371 | 1.24 | 346 | 3.58 | 103 |
| *Limonium barceloi* | 3.4 | 9.3 | 366 | 1.19 | 346 | 3.44 | 106 |
| *Limonium biflorum* | 2.4 | 8 | 300 | 0.845 | 316 | 2.67 | 112 |
| *Limonium companyonis* | 3.3 | 8.9 | 371 | 1.42 | 429 | 3.31 | 112 |
| *Limonium echioides* | 3.9 | 10.7 | 364 | 1.46 | 427 | 3.42 | 106 |
| *Limonium ejulabilis* | 2 | 7.6 | 263 | 0.94 | 415 | 2.27 | 116 |
| *Limonium gibertii* | 2.5 | 9.1 | 275 | 1.06 | 431 | 2.46 | 111 |
| *Limonium grosii* | 2.9 | 8.1 | 358 | 1.04 | 328 | 3.17 | 113 |
| *Limonium gymnesicum* | 2.4 | 8.2 | 293 | 0.936 | 388 | 2.41 | 121 |
| *Limonium latebracteatum* | 2.7 | 8.8 | 307 |  | 344 |  |  |
| *Limonium leonardi* | 2.8 | 8.8 | 318 | 1.27 | 438 | 2.90 | 110 |
| *Limonium magallufianum* | 2.6 | 7 | 371 | 0.997 | 297 | 3.36 | 109 |
| *Limonium retusum* | 2.1 | 7.1 | 296 | 0.968 | 396 | 2.44 | 121 |
| *Limonium stenophyllum* | 2.6 | 8.4 | 310 | 0.976 | 457 | 2.46 |  |
| *Limonium virgatum* | 2.4 | 8.5 | 282 | 0.909 | 381 | 2.83 |  |
| Mean | 2.76 | 8.61 | 320 | 1.09 | 380 | 2.92 | 112 |
| Standard Error | 0.13 | 0.23 | 9 | 0.05 | 12 | 0.13 | 1 |
| *Aegilops biuncialis* | 3.2 | 16.8 | 190 | 0.932 | 470 | 1.98 | 96.3 |
| *Aegilops comosa* | 2.86 | 13.5 | 212 | 0.722 | 360 | 2.01 | 106 |
| *Aegilops cylindrica* | 3.68 | 13.7 | 269 | 1.12 | 451 | 2.48 | 109 |
| *Aegilops juvenalis* | 3.25 | 20.6 | 158 | 0.86 | 492 | 1.75 | 90.4 |
| *Aegilops speltoides* | 3.24 | 16.5 | 196 | 0.86 | 447 | 1.92 | 102 |
| *Aegilops tauschii* | 2.86 | 14.9 | 192 | 0.892 | 495 | 1.80 | 107 |
| *Aegilops triuncialis* | 2.62 | 12.8 | 205 | 0.754 | 380 | 1.98 | 103 |
| *Aegilops uniaristata* | 2.7 | 13.8 | 196 | 0.865 | 450 | 1.92 | 102 |
| *Aegilops vavilovii* | 3.32 | 13.3 | 250 | 0.835 | 363 | 2.30 | 109 |
| Mean | 3.08 | 15.1 | 207 | 0.87 | 434 | 2.01 | 103 |
| Standard Error | 0.11 | 0.8 | 11 | 0.04 | 18 | 0.08 | 2 |
| *Oryza barthii* | 2.5 | 14 | 179 | 0.798 | 479 | 1.67 | 107 |
| *Oryza eichingeri* | 2.5 | 14.1 | 177 | 1.01 | 612 | 1.66 | 107 |
| *Oryza glaberrima*  | 2.7 | 14.9 | 181 | 1.01 | 586 | 1.73 | 105 |
| *Oryza glumaepatula* | 2.4 | 15.2 | 158 | 0.693 | 484 | 1.45 | 109 |
| *Oryza longistaminata* | 2.2 | 15.1 | 146 | 1.02 | 757 | 1.35 | 108 |
| *Oryza meridionalis* | 2.6 | 14.6 | 178 | 0.636 | 382 | 1.66 | 107 |
| *Oryza nivara* | 2.7 | 15.6 | 173 | 0.991 | 611 | 1.62 | 107 |
| *Oryza punctata* | 2.7 | 14.9 | 181 | 0.571 | 342 | 1.87 | 97 |
| *Oryza sativa* | 2.4 | 8.9 | 265 | 0.941 | 369 | 2.65 | 100 |
| Mean | 2.52 | 14.1 | 182 | 0.85 | 514 | 1.74 | 105 |
| Standard Error | 0.06 | 0.7 | 11 | 0.06 | 46 | 0.12 | 1 |
| *Puccinellia distans* | 5.4 | 22.2 | 243 | 1.14 | 488 | 2.34 | 104 |
| *Puccinellia lemmonii* | 5.2 | 28.1 | 185 | 2.06 | 1120 | 1.81 | 102 |
| *Puccinellia maritima* | 5.4 | 20.8 | 260 | 1.65 | 676 | 2.45 | 106 |
| *Puccinellia nuttalliana* | 4 | 25.2 | 159 | 1.08 | 717 | 1.51 | 105 |
| Mean | 5.00 | 24.0 | 212 | 1.48 | 750 | 2.03 | 104 |
| Standard Error | 0.34 | 1.6 | 24 | 0.23 | 133 | 0.22 | 1 |
| *Agriophyllum squarrosum* | 2.8 | 15.4 | 182 | 0.656 | 339 | 1.94 | 93.9 |
| *Agrostis scabra* | 3.6 | 22 | 164 | 1.04 | 653 | 1.59 | 103 |
| *Agrostis stolonifera* | 5.2 | 25.3 | 206 | 1.57 | 802 | 1.96 | 105 |
| *Amphicarpaea bracteata* | 4 | 29 | 138 | 0.978 | 693 | 1.41 | 97.5 |
| *Arabidopsis thaliana* | 3.61 | 9.9 | 364 |  | 333 |  |  |
| *Arctagrostis latifolia* | 5.8 | 21 | 276 | 1.31 | 497 | 2.63 | 105 |
| *Artemisia myriantha* | 3.1 | 26.4 | 117 | 0.903 | 844 | 1.07 | 110 |
| *Artemisia vulgaris L.* | 3.9 | 31.9 | 122 | 0.73 | 626 | 1.16 | 105 |
| *Atriplex glabriuscula* |  | 27 |  |  | 328 |  |  |
| *Avena sativa* | 2.3 | 10.8 | 213 |  |  | 2.13 | 99.9 |
| *B. distachyon* | 2.05 | 11.9 | 172 | 0.613 | 396 | 1.55 | 111 |
| *Beta maritima*  |  |  |  |  |  |  | 94.6 |
| *Beta vulgaris* | 2.9 | 13.9 | 209 | 0.916 | 401 | 2.10 | 99.4 |
| *Brassica oleracea* | 2.1 | 11.8 | 178 |  |  | 1.85 | 96.2 |
| *Bromus anomalus* | 2.9 | 16.9 | 172 | 0.833 | 494 | 1.70 | 101 |
| *Calamagrostis arundinacea* | 4.1 | 22.7 | 181 | 1.07 | 614 | 1.74 | 104 |
| *Calamagrostis canescens* | 2.5 | 15.2 | 164 | 0.992 | 594 | 1.67 | 98.5 |
| *Calamagrostis foliosa* | 3.5 | 20.9 | 167 | 0.527 | 330 | 1.59 | 105 |
| *Calamagrostis inexpansa* | 3.3 | 18.8 | 176 | 0.971 | 608 | 1.58 | 111 |
| *Calamagrostis nutkaensis* | 3.1 | 20.1 | 154 | 0.853 | 601 | 1.41 | 109 |
| *Capsicum annuum* | 1.9 | 9.6 | 198 |  |  | 2.06 | 96 |
| *Chenopodium alba* | 2.91 | 11.2 | 260 | 1.37 | 415 | 3.30 | 78.7 |
| *Chenopodium murale* | 4.4 | 23.8 | 185 | 0.6 | 354 | 1.70 | 109 |
| *Chenopodium petiolare* | 4.4 | 25.6 | 172 | 1.03 | 589 | 1.74 | 98.5 |
| *Chenopodium rubrum* | 4.1 | 14.5 | 283 | 0.998 | 346 | 2.89 | 97.8 |
| *Citrullus ecirrhosus* | 3.1 | 18.9 | 164 | 0.882 | 544 | 1.64 | 99.9 |
| *Citrullus lanatus*  | 2.5 | 19.4 | 129 | 0.616 | 510 | 1.20 | 107 |
| *Coffee arabica* | 2.1 | 11 | 191 |  |  | 1.93 | 98.7 |
| *Crithmum maritimum* | 3.4 | 8.7 | 391 |  | 183 |  |  |
| *Cucurbita maxima* | 2.2 | 9 | 244 |  |  | 2.48 | 98.4 |
| *Dactylis glomerata*  | 3.2 | 10.7 | 299 |  | 453 |  |  |
| *Deschampsia danthonioides* | 4.5 | 22.3 | 202 | 1.09 | 580 | 1.87 | 108 |
| *Desmodium cinereum* | 3 | 12.8 | 234 | 0.97 | 403 | 2.40 | 97.5 |
| *Desmodium intortum* | 3.3 | 14.2 | 232 | 0.927 | 394 | 2.35 | 98.7 |
| *Desmodium psilocarpum* | 3.6 | 15.6 | 231 | 1.09 | 452 | 2.41 | 95.9 |
| *Diplotaxis ibicensis* |  |  |  |  |  |  | 95.6 |
| *Elymus farctus* | 3.3 | 19.5 | 169 | 0.476 | 300 | 1.60 | 106 |
| *Erythrina flabelliformis* | 3.6 | 18.4 | 196 | 1.36 | 665 | 2.03 | 96.4 |
| *Espeletia schultzii* |  | 23.3 |  |  |  |  |  |
| *Eucalyptus moorei* | 3.2 | 10 | 320 |  | 285 |  |  |
| *Eucalyptus neglecta* | 2.5 | 7.9 | 316 |  | 230 |  |  |
| *Euphorbia helioscopia* | 1.9 | 11.5 | 165 | 0.77 | 453 | 1.71 | 96.8 |
| *Euphorbia microsphaera* | 4.5 | 25.8 | 174 | 0.954 | 546 | 1.75 | 99.7 |
| *Festuca gigantea* | 5.1 | 31.2 | 163 | 0.902 | 595 | 1.51 | 108 |
| *Festuca pratensis* | 5.1 | 23.1 | 221 | 1.43 | 686 | 2.08 | 106 |
| *Flueggea suffruticosa* | 3.4 | 19.2 | 177 | 0.96 | 547 | 1.75 | 101 |
| *Foeniculum vulgare* | 4.4 | 20.7 | 213 | 1.14 | 512 | 2.25 | 94.3 |
| *Glycine canescens* | 2.6 | 17.2 | 151 | 0.914 | 587 | 1.56 | 97.1 |
| *Glycine max* | 2 | 10.3 | 195 | 1.25 | 475 | 2.10 | 92.9 |
| *H. vulgare*  | 3.99 | 15.2 | 263 | 1.2 | 465 | 2.57 | 102 |
| *Helianthus annuus*  |  |  |  |  |  |  | 73.6 |
| *Helianthus maximus* |  | 10 |  |  |  |  | 77 |
| *Hordeum brachyantherum* | 2.9 | 16.2 | 179 | 0.656 | 371 | 1.77 | 101 |
| *Hordeum murinum* | 4.2 | 21.5 | 195 | 0.993 | 511 | 1.95 | 100 |
| *Hordeum vulgare*  | 2.4 | 9 | 267 |  |  | 2.93 | 91.0 |
| *Hypericum balearicum* |  |  |  |  |  |  | 93.6 |
| *Ipomoea batatas* | 2.5 | 12 | 208 |  |  | 2.12 | 98.5 |
| *Iris douglasiana* | 3.5 | 9.7 | 361 |  | 413 |  |  |
| *Kundmannia sicula* |  |  |  |  |  |  | 89.2 |
| *Lablab purpureus* | 5.3 | 21.7 | 244 | 1.49 | 556 | 2.68 | 91.1 |
| *Lactua sativa* | 2.2 | 11.1 | 198 |  |  | 2.11 | 94 |
| *Lepidium campestre* | 3.4 | 15.8 | 215 | 0.778 | 336 | 2.32 | 92.8 |
| *Lolium multiflorum* | 4.5 | 29.1 | 155 | 1.14 | 740 | 1.55 | 99.9 |
| *Lolium perenne* |  | 16 |  |  | 500 |  | 80 |
| *Lolium rigidum* | 4.7 | 25 | 188 | 0.973 | 520 | 1.88 | 100 |
| *Lycopersicon ensculentum* |  | 8.2 |  |  |  |  | 82 |
| *Lysimachia minoricensis* |  |  |  |  |  |  | 93.8 |
| *Macrotyloma uniflorum* | 4.4 | 25.2 | 175 | 0.897 | 519 | 1.73 | 101 |
| *Manihot esculenta* | 1.9 | 10.6 | 180 |  |  | 1.75 | 103 |
| *Medicago sativa* | 1.7 | 12.7 | 134 |  |  | 1.55 | 86.3 |
| *Mentha aquatica* |  |  |  |  |  |  | 97.2 |
| *Mercurialis annua* | 3.4 | 17 | 200 | 0.87 | 417 | 2.09 | 95.7 |
| *Musa velutina* | 3.2 | 19 | 168 | 0.852 | 564 | 1.52 | 111 |
| *Nicotiana glauca Grah.* |  |  |  |  |  |  | 73.7 |
| *Nicotiana tabacum* | 3.37 | 9.96 | 338 | 1.19 | 291 | 3.91 | 86.5 |
| *Pallenis maritima* | 2.7 | 6.4 | 422 |  | 321 |  |  |
| *Petroselinum cripsum* |  | 11.6 |  |  |  |  | 77 |
| *Phaseolus carteri* | 3.2 | 14.2 | 225 | 1.13 | 422 | 2.67 | 84.5 |
| *Phaseolus coccineus* | 3.9 | 15.6 | 250 | 1.18 | 491 | 2.40 | 104 |
| *Phaseolus lunatus* | 3.2 | 17.3 | 185 | 0.981 | 537 | 1.83 | 101 |
| *Phaseolus vulgaris* | 2.6 | 14 | 186 | 0.761 | 463 | 1.81 | 102 |
| *Pistacia lentiscus* |  |  |  |  |  |  | 97.2 |
| *Pisum sativum* |  |  |  |  |  |  | 90.2 |
| *Plantago lanceolata L.* |  |  |  |  |  |  | 77.3 |
| *Poa palustris* | 4.2 | 19.2 | 219 | 1.1 | 562 | 1.95 | 112 |
| *Pueraria montana* | 2.7 | 20.9 | 129 | 0.871 | 679 | 1.28 | 101 |
| *Rhamnus alaternus* |  |  |  |  |  |  | 94.7 |
| *Rhamnus ludovici-salvatoris* |  |  |  |  |  |  | 94.4 |
| *S. cereale*  | 3.23 | 20.2 | 160 | 0.826 | 472 | 1.75 | 91.5 |
| *Sideritis cretica subsp. spicata* | 2 | 7.8 | 256 |  | 328 |  |  |
| *Solanum lycopersicum* | 2.3 | 9.7 | 237 |  |  | 2.57 | 92.4 |
| *Solanum tuberosum* | 2 | 9.6 | 208 |  |  | 2.18 | 95.4 |
| *Sphenostylis stenocarpa* | 2.8 | 17.4 | 161 | 0.981 | 574 | 1.72 | 93.6 |
| *Spinacia oleracea* | 2.76 | 12.1 | 228 | 1.39 | 461 | 2.53 | 90.5 |
| *Steinchisma laxa* | 2.3 | 7.7 | 299 | 1.35 | 419 | 3.27 | 91.4 |
| *T. aestivum*  | 3.45 | 16.8 | 205 | 0.917 | 429 | 2.15 | 95.7 |
| *T. dicoccon1* | 3.51 | 16.1 | 218 | 1.02 | 434 | 2.33 | 93.5 |
| *T. monococcum* | 3.18 | 14 | 227 | 0.877 | 401 | 2.18 | 104 |
| *T. timonovum* | 3.48 | 16.8 | 207 | 1.02 | 495 | 2.05 | 101 |
| *T. timopheevii* | 3.43 | 16.2 | 212 | 0.893 | 429 | 2.08 | 102 |
| *Tephrosia candida* | 2.2 | 15.9 | 138 | 0.667 | 481 | 1.41 | 97.8 |
| *Tephrosia purpurea* | 2.2 | 12.4 | 177 | 0.575 | 333 | 1.72 | 103 |
| *Tephrosia rhodesica* | 2.2 | 13.7 | 161 | 0.988 | 565 | 1.75 | 91.6 |
| *Tetragonium expansa* |  | 13 |  |  | 600 |  | 81 |
| *Teucrium heterophyllum* | 2.7 | 6.7 | 403 |  | 359 |  |  |
| *Trachycarpus fortunei* | 2.8 | 9 | 311 |  | 364 |  |  |
| *Trifolium repens*  |  | 13.1 |  |  | 565 |  |  |
| *Triticale*  | 3.48 | 15.7 | 222 | 0.905 | 396 | 2.28 | 97.2 |
| *Triticum aestivum* | 3.18 | 13.1 | 243 | 1.39 | 543 | 2.55 | 95.4 |
| *Triticum baeoticum* | 3.8 | 19.7 | 193 | 1.8 | 905 | 2.01 | 96 |
| *Urtica atrovirens*  |  |  |  |  |  |  | 90.2 |
| *Urtica membranacea* |  |  |  |  |  |  | 102 |

**Table S2.** Kinetic parameters *V* (s-1), *K* (M), *S* (s-1.mM-1) and *S*C/O for C3, transitional and C4 species.

|  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Species** |  | ***V*C** | ***K*C** | ***S*C** | ***V*O** | ***K*O** | ***S*O** | ***S*C/O** |
| *Flaveria cronquistii*   | C3 | 3.04 | 10.3 | 297 | 2.34 | 431 | 3.51 | 84.6 |
| *Flaveria pringlei*   | C3 | 2.80 | 12.2 | 229 | 1.61 | 321 | 2.63 | 86.9 |
| *Flaveria angustifolia*  | C3-C4 | 2.82 | 12.8 | 220 |  |  | 2.53 | 86.8 |
| *Flaveria anomala*   | C3-C4 | 3.8 | 10.7 | 355 | 2.75 | 605 | 4.56 | 77.9 |
| *Flaveria chloraefolia*   | C3-C4 | 3.35 | 12.4 | 270 | 2.46 | 740 | 3.31 | 81.6 |
| *Flaveria floridana*   | C3-C4 | 3.22 | 13.2 | 244 | 1.55 | 530 | 2.92 | 83.6 |
| *Flaveria linearis*   | C3-C4 | 3.43 | 12.5 | 274 | 1.46 | 415 | 3.51 | 78.1 |
| *Flaveria ramosissima*   | C3-C4 | 2.77 | 12 | 231 | 2.09 | 722 | 2.89 | 79.8 |
| *Flaveria sonorensis*   | C3-C4 | 2.69 | 10.2 | 264 | 2.46 | 785 | 3.13 | 84.3 |
| *Flaveria brownii*   | C4 like | 2.58 | 12.8 | 202 | 0.907 | 378 | 2.41 | 83.8 |
| *Flaveria palmeri*   | C4 like | 3.54 | 13.5 | 262 | 0.603 | 193 | 3.13 | 83.8 |
| *Flaveria vaginata*   | C4 like | 3.78 | 21.4 | 177 | 1.97 | 880 | 2.24 | 78.7 |
| *Flaveria australasica*  | C4  | 3.84 | 22 | 175 | 0.697 | 309 | 2.62 | 77.2 |
| *Flaveria bidentis*  | C4  | 4.13 | 20.0 | 206 | 1.48 | 530 | 2.61 | 78.8 |
| *Flaveria kochiana*  | C4  | 3.68 | 22.7 | 162 |  | 150 | 2.11 | 77 |
| *Flaveria trinervia*   | C4  | 3.85 | 18.2 | 212 | 2.15 | 671 | 2.73 | 77.7 |
| Mean |  | 3.33 | 14.8 | 236 | 1.72 | 521 | 2.91 | 81.3 |
| Standard Error |  | 0.12 | 1.1 | 13 | 0.17 | 58 | 0.16 | 0.9 |
| *Panicum bisulcatum*  | C3 | 2.6 | 7.8 | 333 | 1.57 | 416 | 3.80 | 87.7 |
| *Panicum milioides*  | C3-C4 | 2.2 | 7.4 | 297 | 1.24 | 387 | 3.22 | 92.3 |
| *Panicum amarum*   | C4  | 3.2 | 33.1 | 97 | 0.86 | 800 | 1.08 | 89.5 |
| *Panicum antidotale*  | C4  | 3.9 |  |  |  |  |  | 74.5 |
| *Panicum coloratum*  | C4  | 3.4 | 11.1 | 306 | 1.59 | 445 | 3.61 | 84.8 |
| *Panicum deustum*  | C4  | 5 | 15.4 | 325 | 1.17 | 306 | 3.83 | 84.8 |
| *Panicum dichotomiflorum*  | C4  | 3.1 | 36.3 | 85 | 1.41 | 1540 | 0.92 | 92.6 |
| *Panicum milliaceum*  | C4  | 2.1 | 7.2 | 292 | 1.13 | 313 | 3.65 | 79.9 |
| *Panicum monticola*  | C4  | 5.3 | 18.2 | 291 | 1.97 | 543 | 3.67 | 79.4 |
| *Panicum phragmitoides*  | C4  | 2.8 | 25.1 | 112 | 0.707 | 687 | 1.04 | 107 |
| *Panicum virgatum*  | C4  | 3.3 | 12.7 | 260 | 0.854 | 271 | 3.15 | 82.6 |
| Mean |  | 3.35 | 17.4 | 240 | 1.25 | 571 | 2.80 | 86.6 |
| Standard Error |  | 0.31 | 3.38 | 32 | 0.12 | 120 | 0.40 | 2.9 |
| *Amaranthus edulis* | C4  | 4.14 | 18.2 | 227 | 0.847 | 289 | 2.94 | 77.5 |
| *Amaranthus hybridus* | C4  | 3.8 | 16 | 238 | 1.85 | 640 | 2.97 | 80 |
| *C. dactylon* | C4  |  | 21 |  |  | 402 |  | 89.2 |
| *Cenchrus ciliaris* | C4  | 6 | 19 | 316 | 2.1 | 470 | 4.52 | 69.9 |
| *Chrysanthellum indicum*  | C4  | 4.7 | 28.1 | 167 | 1.21 | 598 | 2.03 | 82.4 |
| *Echinochloa crus-galli* | C4  |  | 18.4 |  |  |  |  | 83 |
| *Eragrostis tef* | C4  | 7.1 | 34.9 | 203 | 1.46 | 640 | 2.29 | 89 |
| *Megathyrsus maximus* | C4  | 5.3 | 13.9 | 381 | 1.25 | 265 | 4.75 | 80.3 |
| *P. dilatatum* | C4  |  | 19.9 |  |  | 415 |  | 88 |
| *Potulaca oleraca* | C4  | 5.9 | 13.6 | 434 |  |  | 5.56 | 78 |
| *Saccharum officinarum* | C4  | 3.9 | 26.3 | 148 |  |  | 1.80 | 82.2 |
| *Setaria italica* | C4  |  | 32.1 |  |  |  |  | 58 |
| *Setaria viridis* | C4  | 5.67 | 18.1 | 313 | 2.77 | 619 | 4.31 | 72.7 |
| *Sorghum bicolor* | C4  | 5.4 | 29.9 | 181 |  |  | 2.58 | 70 |
| *Urochloa mosambicensis* | C4  | 5.7 | 14.8 | 385 | 2.14 | 464 | 4.67 | 82.5 |
| *Urochloa panicoides* | C4  | 5.6 | 15.4 | 364 | 2.04 | 444 | 4.64 | 78.3 |
| *Z. japonica* | C4  |  | 18.5 |  |  | 403 |  | 84.1 |
| *Zea mays* | C4  | 4.19 | 30.6 | 137 | 0.920 | 59675 | 1.68 | 81.6 |
| Mean |  | 5.18 | 21.6 | 269 | 1.66 | 480000 | 3.44 | 79.0 |
| Standard Error |  | 0.27 | 1.6 | 28 | 0.20 | 36 | 0.37 | 1.8 |
|  |  |  |  |  |  |  |  |  |

**Appendix**

**Derivation of the kinetic equations**: The concentrations used in the kinetic equations are *E*: activated form of the enzyme; *R*: unbound RuBP; *ER*: RuBisCO…RuBP complex; *ER\**: RuBisCO…enediolate of RuBP complex; *C*: free CO2; *O*: free O2; *ERC*: RuBisCO…carboxylated intermediate complex; *ERO*: RuBisCO…oxygenated intermediate complex; *ERP*: RuBisCO…carboxylated product complex; *ERX*: RuBisCO…oxygenated product complex; *G*: 3-phosphoglyceric acid; *Q*: 2-phospho-glycolate.

The mass balance equation for the kinetic mechanism (Fig. 1) is given by (*Et* is the total activated enzyme concentration)

*E* + *ER* + *ER\** + *ERC* + *ERO* + *EP* + *EX* – *Et* = 0 (A1)

The steady state ordinary differential equations (ODEs) for this kinetic scheme are

 (A2)

 (A3)

 (A4)

 (A5)

 (A6)

 (A7)

It is convenient to define the following constants:

From the above steady state ODEs we can readily express the concentrations of free enzyme *E* and all reaction intermediates in terms of the product complexes (either *EP* or *EX*). For the carboxylation reaction (*EP*) we obtain (assuming only that product release is “irreversible” i.e.):

Summing (A2) to (A7):  (A8)

From (A5): *ERC* = *EP* (A9)

From (A7): *ERO* = *EX* (A10)

From (A4) + (A5) and (A9):  (A11)

From (A6) + (A7), (A10) and (A11):  (A12)

From (A10) and (A12): (A13)

From (A2), (A8), (A11) and (A12):

  (A14)

Substituting (A8)-(A14) into (A1) and factorizing we get the steady state equation in the form

 (A15)

where the coefficientsare given by

 (A16a)

 (A16b)

 (A16c)

 (A16d)

The rate of CO2 consumption is given by

 (A17)

Rewriting (A15) in terms of and substituting the result into (A17) gives

 (A18)

When both substrates, *R* and *C*, are saturating the maximum rate of CO2 consumption,, is obtained as,

 (A19)

Substituting (A16a) into (A19) and rearranging we get for  in terms of the rate constants



Finally, rewriting (A18) in terms of  gives the familiar (e.g. ([Farquhar, 1979](#_ENREF_10))) general form of the steady state rate equation,

 (A20)

where . (A21)

It immediately follows that the rate of oxygen consumption by the enzyme can be written as



where  and .

The Michaelis-Menten equation (A20) for the single substrate *C* when *R* is saturating becomes



From (A21), (A16a) and (A16c):

 (A22)

Substituting, ,  and 

into (A22) yields the Michaelis constant in the presence of the other (*O*) substrate



where  (A23)

and  (A24)

The specificities of each of the reactions are then

 and 

and so the specificity of carboxylation relative to oxygenation (relative specificity) is given by

 (A25)

In terms of the rate constants we find the coefficients of  and :

 (A26)

 (A27)

Thus the range of  is limited to [0,1].