Dr. Greg A. Constable

I. Position and Address:

Senior Principal Research Scientist, Commonwealth Scientific and Industrial Research Organisation (CSIRO) Agriculture Flagship
Fellow of CSIRO
Chairman of the International Cotton Researchers Association
Adjunct Professor at the School of Crop Sciences, University of Sydney.

Contact details:
CSIRO Agriculture Flagship, Locked Bag 59, Narrabri NSW 2390, Australia
greg.Constable@csiro.au
Phone: +61 428 106 665

II. Field of research:

Dr. Constable's research interests include cotton breeding, physiology and crop management systems. He has driven successful and impactful research in cotton breeding and management for:

- improved yield
- disease tolerance
- high fibre quality
- water use efficiency
- the rapid development of genetically modified breeding lines with multiple traits
- the consolidation of significant sales of CSIRO cotton varieties in Australia and internationally.
- Significant number of key research publications outlining key international findings in cotton research.

III. Awards/recognition:

National

2011	CSIRO Chairman's Medal for industry impact (with Danny Llewellyn, Shiming Liu, Peter Reid and members of the cotton breeding and biotechnology teams)
2007	Elevated to a CSIRO Fellow
2006	Australian Academy of Technological Sciences and Engineering Clunies Ross Award with Danny Llewellyn and Gary Fitt
2006	Australian Cotton Growers Research Association Researcher of the Year
2005	Australian Government Prize for Rural innovation (team)
2003	Australian business magazine *The Bulletin* – Australia's Smartest Scientist
2003	CSIRO Chairman's Medal with Danny Llewellyn
2002	Australian Government Centenary Medal for services to plant production and processing with Danny Llewellyn

2000	Elected a Fellow of the Australian Academy of Technological Sciences and Engineering for his research including for his work in helping to develop: • higher yield management packages • improved sustainability from better resource management • reduced insecticide use due to the introduction of pest resistant, genetically modified cotton varieties.
1987	Australian Cotton Growers Research Association Researcher of the Year
1985	CSIRO Plant Industry Chiefs Award

International

2009	Outstanding Research Award in Cotton Physiology at the US Beltwide Cotton Conferences

IV. Publications:

Chapters published

As main author/editor:

1. **Constable**, G.A., Thomson, N.J. and Reid, P.E. (2001). Approaches utilized in breeding and development of cotton cultivars in Australia. In: Genetic Improvement of Cotton: Emerging Technologies. JN Jenkins and S Saha (Eds). Science Publishers, Enfield. pp 1-15.
2. **Constable**, G.A. and Oosterhuis, D. (2009). Temporal dynamics of leaves and canopies. In: Cotton Physiology. D Oosterhuis, JM Stewart and J Heitholt (eds). Springer p72-79
3. **Constable**, GA. DJ Llewellyn, SA Walford and JD Clement (2015). Cotton Breeding for Fiber Quality Improvement. In Industrial Crops: Breeding for BioEnergy & Bioproducts. Edited by Drs. Mark Cruz & David Dierig - Springer Science + Business Media.

As co-author/co-editor:

4. Hearn, A. B. and **Constable**, G. A. (1984). Cotton. In: The Physiology of Tropical Field Crops. Eds. P. R. Goldsworthy and N. M. Fisher. (J. Wiley and Sons, Chichester). pp. 495-527.
5. Hodges, S. and **Constable**, G.A. (2009). Plant responses to mineral deficiencies and toxicities. In: Cotton Physiology. D Oosterhuis, JM Stewart and J Heitholt (eds). Springer p142-161
6. Bange M.P.**, Constable, G.A**., McRea D., and Roth G. (2010). Cotton. In C. Stokes and M. Howden (eds), 'Adapting agriculture to climate change: Preparing Australian agriculture, forestry and fisheries for the future'. (CSIRO Publishing, Melbourne, Australia).

Peer-reviewed research papers published

International:

7. **Constable**, G. A., Harris, N. V. and Paull, R. E. (1976). The effect of planting date on yield and some fibre properties of cotton in the Namoi Valley. *Aust. J. Exp. Agric. Anim. Husb*. 16, 265-271.
8. **Constable**, G. A. (1976). Temperature effects on the early field development of cotton. *Aust. J. Exp. Agric. Anim. Husb*. 16, 905-910.
9. **Constable**, G. A. (1977). Narrow row cotton in the Namoi Valley. 1. Growth yield and quality of four cultivars*. Aust. J. Exp. Agric. Anim. Husb*. 17, 135-142.
10. **Constable**, G. A. (1977). Narrow row cotton in the Namoi Valley. 2. Plant population and row spacing*. Aust. J. Exp. Agric. Anim. Husb*. 17,143-147.

11. **Constable**, G. A. and Gleeson, A. C. (1977). Growth and distribution of dry matter in cotton. *Aust. J. Agric. Res*. 28, 249-256.
12. **Constable**, G. A., Sheridan, K. P. and Gleeson, A. C. (1977). Effects of sequential defoliation on lucerne (Medicago sativa L.). *Aust. J. Agric. Res*. 28, 769-767.
13. **Constable**, G. A. (1977). The effect of planting date on soybeans in the Namoi Valley N. S. W. *Aust. J. Exp. Agric. Anim. Husb.* 17, 148-155.
14. **Constable**, G. A. and Hearn, A. B. (1978). Agronomic and physiological responses of soybean and sorghum crops to irrigation. 1. Growth development and yield. *Aust. J. Plant. Physiol*. 5, 159- 167.
15. **Constable**, G. A. and Rose, I. A. (1980). Response of nine genotypes of irrigated soybeans to planting pattern and sowing date. *Aust. J. Exp. Agric. Anim. Husb*. 20, 88-93.
16. **Constable**, G. A. and Rawson, H. M. (1980). Effect of leaf position, expansion and age on photosynthesis, transpiration and water use efficiency of cotton. *Aust. J. Plant. Physiol*. 7, 89-100.
17. **Constable**, G. A. and Rawson, H. M. (1980). Carbon production and utilisation in cotton: inferences from a carbon budget. *Aust. J. Plant. Physiol*. 7, 539-553.
18. **Constable**, G. A. and Rawson, H. M. (1980). Photosynthesis, respiration and transpiration of cotton fruit. *Photosynthetica* 14, 557-563.
19. Rawson, H. M. and **Constable**, G. A. (1980). Carbon production of sunflower cultivars in field and controlled environments. 1. Photosynthesis and transpiration of leaves, stems and heads. *Aust. J. Plant. Physiol*. 7, 553-573.
20. Rawson, H. M., **Constable**, G. A. and Howe, G. N. (1980). Carbon production of sunflower cultivars in field and controlled environments. 2. Leaf growth. *Aust. J. Plant. Physiol*. 7, 575-586.
21. **Constable**, G. A. and Hearn, A. B. (1980). Irrigation for crops in a sub-humid environment. 1. The effect of irrigation on the growth and yield of soybeans. *Irrig. Sci.* 2, 1-12.
22. Mason, W. K., **Constable**, G. A. and Smith, R. C. G. (1980). Irrigation for crops in a sub-humid environment. 2. The water requirements of soybeans. *Irrig. Sci.* 2, 13-22.
23. Hearn, A. B. and **Constable**, G. A. (1981). Irrigation for crops in a sub-humid environment. 5. Stress day analysis for soybeans and an economic evaluation of strategies. *Irrig. Sci.* 3, 1-16.
24. **Constable**, G. A. and Hearn, A. B. (1981). Irrigation for crops in a sub-humid environment. 6. Effects of irrigation and nitrogen fertiliser on growth, yield and quality of cotton. *Irrig. Sci*. 3, 17-29.
25. **Constable**, G. A. and Rawson, H. M. (1982). Distribution of a 14-C label from cotton leaves: consequences of changed water and nitrogen status. *Aust. J. Plant. Physiol.* 9, 735-747.
26. Hearn, A. B. and **Constable**, G. A. (1984). Irrigation for crops in a sub-humid environment. 7. Stress day analysis for cotton and an economic evaluation of strategies. *Irrig. Sci*. 5, 75-94.
27. Marcellos, H. and **Constable**, G. A. (1986). Effects of plant density and sowing date on grain yield of faba beans (Vicia faba L.) in northern New South Wales. *Aust. J. Exp. Agric*. 26, 493-496.
28. Turner, N. C. Hearn, A. B., Begg, J. E. and **Constable**, G. A. (1986). Cotton (Gossypium hirsutum L.): Physiological and morphological responses to water deficits and their relationship to yield. *Field Crops Res.* 14, 153-170.
29. **Constable**, G. A. (1986). Growth and light receipt by mainstem cotton leaves in relation to plant density in the field. *Agric. For. Meteorol*. 37, 279-292.

30. **Constable**, G. A. and Rose, I. A. (1988). Variability of soybean response to temperature, daylength and rate of change in daylength. *Field Crops Res*. 18, 57-69.
31. **Constable**, G. A., Rochester, I. J. and Cook, J. B. (1988). Zinc, copper, iron, manganese and boron uptake by cotton on cracking clay soils of high pH. *Aust. J. Exp. Agric*. 28, 351-6.
32. **Constable**, G. A. and Rochester, I. J. (1988). Nitrogen application to cotton on clay soil: timing and soil testing. *Agron. J*. 80, 498-502.
33. **Constable**, G. A., Rochester, I. J. and Hodgson, A. S. (1990). A comparison of drip and furrow irrigated cotton on a cracking clay soil. 1. Growth and nitrogen uptake. *Irrig. Sci*. 11, 137-142.
34. Hodgson, A. S., **Constable**, G. A., Duddy, G. R. and Daniells, I. G. (1990). A comparison of drip and furrow irngated cotton on a cracking clay soil. 2. Water use efficiency, waterlogging, root distribution and soil structure. *Irrig. Sci*. 11, 143-148.
35. **Constable**, G. A. and Hodgson, A. S. (1990). A comparison of drip and furrow irrigated cotton on a cracking clay soil. 3. Yield and quality of four cultivars. *Irrig. Sci*. 11, 149-153.
36. **Constable**, G. A. (1991). Mapping the production and survival of fruit on field-grown cotton. *Agron. J*. 83, 374-378.
37. Rochester, I. J., **Constable**, G. A. and MacLeod, D. A. (1991). Mineral nitrogen dynamics in a fallow grey clay. *Aust. J. Exp. Agric*. 31, 237-244.
38. Rochester, I. J., **Constable**, G. A. and MacLeod, D. A. (1991). Ammonia loss from soil during incubation and drying. *Commun. Soil Sci. Plant Anal*. 22, 1325-1334.
39. **Constable**, G. A., Rochester, I. J., Betts, J. H. and Herridge, D. F. (1991). Prediction of nitrogen fertilizer requirement in cotton using petiole and sap nitrate. *Commun. Soil Sci. Plant Anal.* 22, 1315-1324.
40. Allen, S. J., Hodgson, A. S. and **Constable**, G. A. (1992). The effects of various agronomic practices on the incidence of bacterial blight of cotton. Plant *Protection Quarterly* 7(2), 55-58.
41. **Constable**, G. A., Rochester, I. J. and Daniells, I. G. (1992). Cotton yield and nitrogen requirement is modified by crop rotation and tillage method. *Soil and Till Res* 23, 41- 59.
42. Rochester, I.J, **Constable**, G.A. and MacLeod, D.A. (1992). Preferential nitrate immobilization in alkaline soils. *Australian Journal of Soil Research* 30, 737-749.
43. Rochester, I.J, **Constable**, G.A. and MacLeod, D.A. (1993). Cycling of fertilizer and cotton crop residue N. *Australian Journal of Soil Research* 31, 597-609.
44. Freney, J.R., Chen, D.L., Mosier, A.R., Rochester, I.J., **Constable**, G.A. and Chalk, P.M. (1993). Use of nitrification inhibitors to increase fertilizer N recovery and lint yield in irrigated cotton. *Fertilizer Research* 34, 37-44.
45. Rochester, I.J., Gaynor, H., **Constable**, G.A. and Saffigna, P.G. (1994). Etridiazole may conserve fertilizer N and increase lint yield of irrigated cotton. *Australian Journal of Soil Research* 32, 1287-1300.
46. Rochester, I.J., **Constable**, G.A. and Saffigna, P.G. (1996). Effective nitrification inhibitors may improve fertilizer recovery in irrigated cotton. *Biology and Fertility of Soils* 23, 1-6.
47. Rochester IJ, **Constable** GA and Saffigna PG. (1997). Retention of cotton stubble enhances N fertilizer recovery and lint yield of irrigated cotton. *Soil and Tillage Research* 41, 75-86.
48. Rochester, I.J., Peoples, M.B., **Constable**, G.A. and Gault, R.R. (1998). Faba beans and other legumes add Nitrogen to irrigated cotton cropping systems. *Aust J. Experimental Agriculture* 38, 253-260.

49. Rochester I.J. and **Constable** G.A. (2000). Denitrification and immobilisation in flood-irrigated alkaline grey clays as affected by nitrification inhibitors, wheat straw and soil texture. *Australian Journal of Soil Research* 38, 633-642.
50. Rochester I.J., Peoples M.B., Hulugalle N.R., Gault R.R. and **Constable** G.A. (2000). Using legumes to enhance nitrogen fertility and soil condition in cotton cropping systems*. Field Crops Research 70: 27-41.*
51. Rochester I.J., Peoples M.B. and **Constable** G.A. (2000). Assessing the nitrogen nutrition of cotton grown after legume crops. *Field Crops Research* 70: 43-53.
52. **Constable**, G.A. Reid, P.E. and Stiller, W.N. (2000). Australian cotton varieties. *Cotton Outlook, Australia 2000 Special Edition*, pp 58-60.
53. **Constable**, G.A. (2000). The components of high yields in Australia*. ICAC Recorder*. 18(3), 3-8.
54. Rochester IJ, Peoples MB and **Constable** GA (2001). Estimation of the N fertilizer requirement of cotton grown after legume crops. *Field Crops Research* **70**: 43-53.
55. Yeates, S. J., **Constable**, G. A. And McCumstie, T. (2002). Developing management options for mepiquat chloride in tropical winter season cotton. *Field Crops Res*. 74, 217-230.
56. Stiller, W.N., Reid, P.E. and **Constable**, G.A. (2004). Maturity and leaf shape as traits influencing cotton cultivar adaptations and agronomic water use efficiency under raingrown conditions. *Agronomy Journal*. 96: 656-664.
57. Yeates, S.J., **Constable**, G.A. and McCumstie, T. (2005). Cotton growth and yield after seed treatment with Mepiquat chloride in the tropical winter season. *Field Crops Research*, 93, 122-131.
58. Stiller, WN, Read, JJ, **Constable**, G.A. and Reid, P.E. (2005). Selection for water use efficiency traits in a cotton breeding program: Cultivar differences. *Crop Science*. 45: 1107-1113.
59. Stiller, W.N., Reid, P.E. and **Constable**, G.A. (2004). Maturity and leaf shape as traits influencing cotton cultivar adaptations and agronomic water use efficiency under raingrown conditions. *Agronomy Journal*. 96: 656-664.
60. Higgins, T.J. and **Constable**, G.A. (2004). Development, regulation and use of genetically modified crops in Australia. *Farm Policy Journal*. 1: 14-20.
61. Stiller, WN, Read, JJ, **Constable**, G.A. and Reid, P.E. (2005). Selection for water use efficiency traits in a cotton breeding program: Cultivar differences. *Crop Science*. 45: 1107-1113.
62. Knox, O.G., **Constable**, G.A., Pyke, B. and Gupta V.S.R. Vadakattu, G.V.S.R.(2006). Environmental impact of conventional and Bt insecticidal cotton expressing one and two Cry genes in Australia. *Aust J Agric Res* **57**, 501-9.
63. Whitehouse M.E.A., Wilson L.J, **Constable** G.A. (2007). Target and non-target effects on the invertebrate community of Vip cotton, a new insecticidal transgenic *Aust J Agric Res* **58**, 273-285.
64. Llewellyn, DJ, Tyson, C, **Constable**, GA, Duggan, B, Beale, S and Steel, P (2007). Containment of regulated GM cotton under Australian conditions. *Agriculture Ecosystems and Environment* 121, 419-429
65. **Constable**, G.A. and Higgins, T.J. (2007).Cottoning on to GM crops in Australia. *Journal of Biolaw and Business*. Pp 59-62.
66. Llewellyn, DJ, Tyson, C, **Constable**, GA, Duggan, B, Beale, S and Steel, P (2007). Containment of regulated GM cotton under Australian conditions. *Agriculture Ecosystems and Environment* 121, 419-429.
67. Llewellyn, DJ, Amarasinghe, R, Faivre-Nitschke, E, Yingru Wu, Udall, J, Dennis, E and **Constable**, GA. (2007). Genomic approaches to the discovery of promoters for sustained expression in cotton (Gossypium hirsutum L.) under

field conditions: expression analysis in transgenic cotton and Arabidopsis of a Rubisco small subunit promoter identified using EST sequence analysis and cDNA microarrays. Plant Biotechnology 23: 437-450.
68. **Constable**, GA, Preston, C and Gupta, VVSR (2007). GM Cotton: benefits, risks and challenges. Invited review paper for *J Aust Inst Agric Sci* **20***, 28-32.*
69. Charles, GW, **Constable**, GA, Llewellyn, DJ and Hickman, MA (2007). Tolerance of cotton expressing a 2,4-D detoxification gene to 2,4-D applied in the field. *Aust. J. Agric. Res*. **58**, 780-787.
70. Chen D, Freney JR, Rochester I, **Constable** GA, Mosier AR and PM Chalk (2007). Evaluation of a polyolefin coated urea (Meister) as a fertilizer for irrigated cotton. *Nutrient Cycling in Agroecosystems* **81**, 245-254.
71. Duggan, Brian L, Yeates, Stephen J. and **Constable,** Greg A. (2008). Bed preparation techniques and herbicide tolerance technology for tropical dry season cotton production. *Trop. Agric*. (Trinidad). 82(3), 233-240.
72. Duggan, B.L., Yeates, S.J., Gaff, N. and **Constable**, G.A. (2008). Phosphorus fertilizer requirements and nutrient uptake of irrigated dry-season cotton grown on virgin soil in tropical Australia. *Communications in Soil Science and Plant Analysis*. **39**: 282-301.
73. Conaty, W.C., Tan, D.K.Y., **Constable**, G.A., Sutton, B.G., Field, D.J. and Mamum, E.A. (2008). Genetic variation for waterlogging tolerance in cotton *Journal of Cotton Science 12:53–61.*
74. Long, RL, Bange, MP, Gordon, SG and **Constable, GA**. (2010). Measuring the Maturity of Developing Cotton Fibers using an Automated Polarized Light Microscopy Technique. *Textile Res. J*. 80, 463-471.
75. Long, RL, Bange, MP, Gordon, SG, van der Sluijs, MHJ, Naylor, GR and **Constable, GA**. (2010). Fiber quality and textile performance of some Australian cotton genotypes. *Crop Sci*. **50**, 1509-1518.
76. Campbell, BT, S. Saha, R. Percy, J. Frelichowski, J. N. Jenkins, W. Park, C. D. Mayee, V. Gotmare, D. Dessauw, M. Giband, X. Du, Y. Jia, **G. Constable**, S. Dillon, I. Y. Abdurakhmonov, A. Abdukarimov, S. M. Rizaeva, A. Abdullaev, P. A. V. Barroso, J. G. Pádua, L. V. Hoffmann and L. Podolnaya. (2010). Status of the Global Cotton Germplasm Resources. *Crop Sci* **50**: 2198-2198.
77. Yeates, SJ, **Constable** GA and McCumstie, T. (2010). Irrigated cotton in the tropical dry season. I: Yield, its components and crop development *Field Crops Research*, 116, 278-289.
78. Yeates, SJ, **Constable** GA and McCumstie, T. (2010). Irrigated cotton in the tropical dry season. II: Biomass accumulation, partitioning and RUE. *Field Crops Research*, 116, 290-299.
79. Yeates, SJ, **Constable** GA and McCumstie, T. (2010). Irrigated cotton in the tropical dry season. III: Impact of temperature, cultivar and sowing date on fibre quality. *Field Crops Research*, 116, 300-307.
80. Bange, Michael P.; Long, Robert L.; **Constable**, Greg A.; et al (2010). Minimizing Immature Fiber and Neps in Upland Cotton. Agronomy Journal 102, 781-789.
81. Bange, MP, **Constable**, GA, Johnston, DB, et al. (2010) A method to estimate the effects of temperature on cotton micronaire. Journal of Cotton Science: **14,** 164-172.
82. Liu S., Llewellyn D. J., Stiller W.N., Jacobs J., Lacape J.-M, **Constable** G.A. (2011) Heritability and predicted selection response of yield components and fibre properties in an inter-specific derived RIL population of cotton. *Euphytica* 178, 309-320.
83. **Constable**, G., Llewellyn, D., Wilson, L. and Stiller, W. (2011). An industry transformed: the impact of GM technology on Australian cotton production. Farm Policy J. 8, 23-41.

84. Clement, JD, **Constable**, GA, Stiller, WN and Liu, SM (2012). Negative associations still exist between yield and fibre quality in cotton breeding programs in Australia and USA. Field Crops Res. 128, 1-7.
85. Clement, JD, **Constable**, GA and Conaty, WC (2013). CO_2 exchange rate does not explain negative associations between lint yield and fiber quality. Journal of Cotton Science: 17, 270-278
86. Long, RL, Bange, MP, Delhom, CD, Church, JS and **Constable**, GA. (2013). An assessment of alternative cotton fibre quality attributes and their relationship with yarn strength. Crop & Pasture Sci.
87. Liu, SM, **Constable**, GA, Reid, PE, Stiller, WN and Cullis, BR. (2013). The interaction between breeding and crop management in improved cotton yield. Field Crops Res. 148, 149-160.
88. Clement, JD, **Constable**, GA and Walford, SA (2014). Improving the precision in estimating cotton seed fibre density. Field Crops Research 160, 77-80
89. Clement, JD, **Constable**, GA and Liu, SL (2014). Increasing fibers per seed or fibre density as a breeding strategy to improve cotton fibre fineness. Field Crops Research. 160, 81-89
90. Conaty, W, Mahan, J, Neilsen, J and **Constable**, G (2014). Vapour pressure deficit aids the interpretation of cotton canopy temperature response to water deficit. Functional Plant Biology. 41(5) 535-546
91. Clement, JD, **Constable**, GA, Stiller, WN and Liu, SM. (2015). Early generation selection strategies for breeding better combinations of cotton yield and fibre quality. Field Crops Research. 172, 145-152
92. Rochester, IJ and **Constable,** GA. (2015). Improvements in nutrient uptake and nutrient use-efficiency in cotton cultivars released between 1973 and 2006. Field Crops Res 173, 14-21.
93. **Constable**, GA and Bange, MP. (2015). Cotton yield potential. Field Crops Res. Submitted (invited review paper).

V. Conferences attended:

Local:

94. **Constable**, G.A. (2012). Mepiquat chloride Physiology and breeding progress. Crop Consultants Conference Goondiwindi. Crop Consultants Australia. Invited plenary speaker.

National:[1]

95. **Constable**, G.A. (2013). The future of Australian cotton research. The Australian Cotton Research Conference. Narrabri, NSW. The Association of Australian Cotton Scientists. Invited plenary speaker.

International:

96. **Constable**, G.A. (1994). Predicting yield responses of cotton to growth regulators. In Challenging the Future: Proceedings of the World Cotton Research Conference-1, Brisbane Australia, Feb 14-17, 1994. G.A. Constable and N.W. Forrester (Eds), CSIRO, Melbourne, pp 3-5. Invited plenary speaker.
97. **Constable**, G.A. (1998). Breeding and variety development of cotton for specific cropping systems. Proceedings of the World Cotton Research Conference-2, Athens Greece, Sept 6-12, 1998. F.M. Gillham (Ed), Petridis, Thessaloniki, pp 3-9. Invited plenary speaker.
98. Rochester, IJ and **Constable**, GA (2003). Leaf nutrient concentrations in cotton cultivars grown in slightly sodic soils. Proceedings of the World Cotton Research Conference-3, Cape Town South Africa, Mar 9-13, 2003. A Swanepoel (Ed), Pretoria, South Africa, pp 681-5.

[1] Details of another 43 national conference papers and/or presentations are available on request.

99. **Constable**, GA (2004). Research's contribution to the evolution of the Australian cotton industry. In: Fischer T et al (2004). *New directions for a diverse planet*: Proceedings for the 4th International Crop Science Congress, Brisbane, Australia, 26 September – 1 October 2004. Invited plenary speaker.
100. Stiller, WN, Reid, PE and **Constable**, GA (2006). Lessons learnt in developing transgenic cotton (*Gossypium hirsutum*) varieties. In: C.F. Mercer (ed). Breeding for Success: Diversity in Action. Proceedings of the 13th Australasian Plant Breeding Conference, Christchurch, New Zealand 18-21 April 2006. pp. 56-61.
101. **Constable**, GA and Bange, MP (2007). Producing and preserving fiber quality: from the seed to the bale. Proceedings of the World Cotton Research Conference-4, Lubbock TX, Sept 10-14, 2007. M Stephens (Ed), Lubbock, TX.
102. **Constable**, GA, Reid, PE and Stiller, WN (2007). Breeding for resistance to a new strain of Fusarium wilt in Australia. Proceedings of the World Cotton Research Conference-4, Lubbock TX, Sept 10-14, 2007. M Stephens (Ed), Lubbock, TX.
103. **Constable**, GA. (2009). Breeding as a business - return on R&D investment in crop improvement. 14th Australasian Plant Breeding Conference and 11th SABRAO Congress, Cairns, 2009. Invited plenary speaker.

VI. Three most innovative achievements:

Dr Constable's outstanding contribution lies in his capacity to clearly define needs and perceive new opportunities which may be addressed by all aspects of cotton research. Dr Constable's knowledge of cotton physiology and his ability to link physiology with cotton varietal development has led to significant breakthroughs in varieties that: are better adapted to rain-fed productions systems; have improved tolerance to heat stress; and have fibre quality attributes that meet future market requirements. Some of these varieties dominate markets in other world production areas.

Major contribution 1: Cotton physiology research

Dr Constable has been involved in cotton physiology research for almost 40 years. His research has significantly influenced understanding of cotton physiology especially in the areas of: leaf photosynthesis and its implications for crop growth; cotton crop phenology leading to development of crop decision tools; cotton water relations in both water limited and waterlogged conditions; and cotton nutrition and crop physiological implications of high fruit retention cotton (especially GM insect protected crops).

Dr Constable's work on leaf photosynthesis was significant in recognising the importance of the location of the leaf (source) in relation to developing fruit (sink). This work highlighted the importance of the leaf subtending the fruit and its relative contribution to its growth. Explicitly this knowledge has been used to develop simulation models and physiological frameworks assessing the impacts of crop stress and the yield potential of cotton. Recently, this work has being used to reassess the yield potential of cotton crops (details soon to be published in an invited article in Field Crops Research). His knowledge in this area has been recognised by contributing to the 'Temporal dynamics of leaves and canopies' chapter in the new edition of *Cotton Physiology*.

In the area of cotton plant water relations, Dr Constable's work with other crop physiologists have quantified the effects of water deficits on crop growth and yield in a range of soil types. He was also part of a small team that conducted the first field research into the effects of waterlogging in cotton. This knowledge is used

today in the Australian crop simulation model OZCOT together with other decision tools to assist scheduling of irrigation and assessment of agronomic practice on crop water use.

Dr Constable's detailed studies into cotton phenology have been instrumental in the development of day degree functions used in a range of decision tools (www.CottASSIST.com.au). His detailed research into plant mapping of fruit development and survival is used today to assist with monitoring cotton crops for yield potential.

Dr Constable has led Australian research into cotton nutrition. With knowledge of cotton development and demand for resources throughout the crop growth, Dr Constable (with Dr Ian Rochester) has developed decision tools that recommend cotton crop nutritional requirements that are dynamic and account for changes in crop size, soil type and phenology.

The introduction of Bollgard technology in Australia has led to issues of higher fruit retention changing the growth dynamics of the crop. Dr Constable led the team that investigated the implications of high fruit retention on cotton physiology. It is his refined knowledge of carbon dynamics, fruit development and survival and plant water relations that has enabled research to influence changes in Bollgard agronomic practice. Examples include modification of sowing time, changes in irrigation management, and nutrition management early in crop growth.

Major contribution 2: Leading the CSIRO cotton breeding program
Dr Constable led one of the most successful cotton breeding programs in the world which employed crop physiology to assist with trait introgression to produce superior varieties.

Dr Constable's knowledge of cotton growth and physiology has enabled him to link these science areas with cotton varietal development. Because of his involvement, there have been significant breakthroughs in varieties that are higher yielding, better adapted to rain-fed productions systems, have improved tolerance to heat stress, and fibre quality attributes that meet future market requirements. In addition to Australia, these varieties are sold globally under the FiberMax™ brand. Some of these varieties now dominate markets in other world production areas.

Major contribution 3: Science leadership
Dr Constable is a crop physiologist, agronomist, and plant breeder, and has brought a wide range of both scientific and management skills to bear on the many challenges faced by the cotton production. Recognising his leadership and ability to integrate across scientific disciplines he was until recently the leader of the whole of CSIRO's cotton research program. Previously, as the inaugural Director of the Cotton Cooperative Research Centre (CRC), he established collaborations across different sectors of the cotton research community, both Australian and internationally.

Through a better scientific understanding of the plant's physiology, its genetics and its responses to different management regimes, as well as a detailed knowledge of, and respect by, the industry at all levels (growers, consultants, marketers, spinners) he has been able to foster the rapid delivery of CSIRO's research into significant agricultural outcomes. He has championed the use of computer decision support tools developed by his research program as a delivery

mechanism for the complex agronomy, physiology and pest management research carried out within CSIRO and the CRC.

Dr Constable is an adjunct professor of the University of Sydney, recognising his ongoing contribution to the development and training of young scientists. He has directly supervised a number of graduate students as well as mentoring and providing direction to numerous others. This is probably one of the best examples of how research at both fundamental and applied levels is able to form the platform for the growth of a vigorous and sustainable cotton production system. Dr Constable's knowledge and leadership are recognised by the invitations, awards, distinctions, and memberships to professional societies listed above and below:

- Program Leader CSIRO Cotton Research – 10 years
- Member American Crop Science Society
- Member Australian Academy of Science
- Member Australian Academy of Technological Sciences and Engineering
- Inaugural Director, first Cooperative Research Centre for Cotton in Australia
- Inaugural Chair, World Cotton Research Conference (WCRC), Brisbane 1994
- Plenary speaker at all the WCRC's held thus far
- Instrumental in organising the first meeting of breeders and molecular biologists in Canberra, 2010. This subsequently became the International Cotton Genome Initiative (ICGI).
- Instrumental in the formation of the Association of Australian Cotton Scientists.