

Peter M. Hirst

Contact

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Academic

PhD The Ohio State University, USA, 1994
B.Hort.Sci. Massey University, New Zealand, 1984

Employment

2019-present Assistant Director, International Programs in Agriculture (IPIA), Purdue University

2013-present	Professor	Department of Horticulture and Landscape Architecture Purdue University West Lafayette, Indiana USA
2002-2013	Associate Professor	
1997-2002	Assistant Professor	
1994 - 1996	Scientist	

1994 - 1996 The Horticulture and Food Research Institute of New Zealand
New Zealand

1990 - 1994 Graduate Research Associate
The Ohio State University

1984 - 1990 Technical Officer
Department of Scientific and Industrial Research (DSIR)
New Zealand

Honors and Awards

- Jefferson Science Fellow – 1 year appointment at USAID. One of 5 people selected nationally across all areas of science, engineering and medicine. National Academies of Science, Engineering and Medicine. 2018-2019.

- Fellow, American Society for Horticultural Science, 2017
- PUCESA Mid Career Extension Award (for outstanding extension specialist with less than 20 years service). Purdue University Cooperative Extension Specialists' Association. 2016
- Experiment Station Excellence in Multistate Research Award from the Experiment Station Committee on Organization and Policy. 2015
- PUCESA Team Award for Indiana Horticultural Congress (Hirst as chair). Purdue University Cooperative Extension Specialists Association. 2015
- Millionaires Club Award, College of Agriculture, Purdue University. 2013
- Golden Apple Distinguished Service Award, Indiana Horticultural Society. 2010
- Guest professor, Northwest Agriculture and Forestry University, Yangling, China (2012 - present)
- NELD (National Extension Leadership Development) program (Colorado, Virginia, Missouri and Maine). 2007
- PUCESA Early Career Extension Award (for outstanding extension specialist with less than 10 years service). Purdue University Cooperative Extension Specialists Association. 2006
- Shepard Award (for best paper published in the Journal of APS), American Pomological Society. 2005
- USDA Award for Superior Service (USDA's most prestigious award presented in recognition to those who have made outstanding contributions supporting USDA's mission). Accepted as chair of NE-183 project. US Secretary of Agriculture, Washington DC. 2001
- CSREES Certificate of Appreciation ("for providing information to apple growers nationally about the likely success of establishing new apple cultivars in different regions") Cooperative State Research, Education, and Extension Service (CSREES). 2001
- Award for Excellence (in recognition of outstanding contributions to the Northeastern regional research) Northeastern Regional Association of State Agricultural Experiment Station Directors. 2000
- U.P. Hedrick Award (for best published paper by a student). American Pomological Society. 1994

University Service (past 5 years)

Department of Horticulture and Landscape Architecture

- Search committee for vegetable specialist faculty position (2013), department head (2013), plant stress faculty position (2014)
- Committee service – space committee, external messaging, mentoring committee for junior faculty (chair), extension committee, teaching committee, social committee

College of Agriculture

- Agenda and policy committee (2013)

- Search committee for Agriculture and Natural Resources program leader (2013-2014), Director of International Programs in Agriculture position (2015-16)

University

- University senate 2010-2015. Elected as departmental representative (2010-2012) and college representative (2013-2015). Committees: advisory, athletic affairs (chair), faculty affairs, grade appeals (chair), nominating
- University faculty mediator (to assist in resolving faculty grievances), 2015-2018

Professional Society Service

- American Society for Horticultural Science (ASHS), Board member and treasurer (2018-2020), Consulting editor Hort Technology (2002-present), editorial board for HortTechnology (2016-2018), finance committee (2014-2020), pomology working group (chair 2000), fruit publication award committee (2003-09; chair 2005-06), membership representative (2015-present), nominations and elections committee (2015-2017), William A. (Tex) Frazier Lecture Series Selection Committee (2016-2020)
- American Pomological Society (APS) – President 2015-2016, executive board (1999-2002), advisory committee (2000-2005), Wilder medal committee, Hedrick award committee, 2nd VP (2011-2012), 1st VP (2013-2014)
- National Coalition for Food and Agricultural Research (NCFAR), board member (ASHS representative), 2017-2021
- International Society for Horticultural Science, Vice-chair of environmental physiology working group (2016-2020), scientific committee for Symposium on Evaluation of Cultivars, Rootstocks and Management Systems for Sustainable Production of Deciduous Fruit Crops, Istanbul 2018
- NC-140 regional research committee – “Rootstock and interstem effects on pome and stone fruit trees” (1997-present, chair 2005)
- NE-183 regional research committee – “Multi-disciplinary evaluation of new apple cultivars” (1997-2005, chair 2001)
- USDA Malus crop germplasm committee (2002 – present)
- US Apple Association – science advisory subcommittee (1998 – present)

National and international professional experience

- State extension specialist (tree fruits) – impact on Indiana apple industry over \$9 m annually
- Conducted international workshops or presentations in Armenia, Australia, Canada, China, Egypt, Kyrgyzstan, Mexico, New Zealand, Tajikistan, and Zambia.
- Invited speaker at state farmer outreach meetings in Idaho, Illinois, Kentucky, Michigan, Missouri, Minnesota, Ohio, Pennsylvania, Washington, Wisconsin.
- Project director ‘Autonomous pruning of specialty crops’, \$6.0 m USDA-SCRI multi-disciplinary and multi-state project (2012–2016)

- Project director ‘Appropriate postharvest handling, processing, and marketing of dried apricots in Tajikistan’. \$300,000. Hort Innovation Lab, USAID
- Chair, Indiana Horticultural Congress (2003 – 2018)

International

In his role as Assistant Director of International Programs in Agriculture (IPIA), Dr. Hirst acts as a catalyst to structure teams of researchers, educators and extension specialists to address international development challenges. He is very involved in international development and has worked in this capacity in Afghanistan, Armenia, China, Egypt, Kyrgyzstan, Mexico, Tajikistan and Zambia. In 2012 he was appointed as a guest professor, North West Agriculture and Forestry University (NWFU), China. Hirst’s international work has been sponsored by a number of programs ranging from a State Department project to support Afghanistan agriculture (capacity building), farmer-to-farmer (USAID), and some industry and privately funded projects. In the last 5 years, members of Hirst’s lab were from Afghanistan, China, Egypt, Iran and Turkey. Hirst is project director of a recently funded Horticulture Innovation lab (USAID) project (\$300,000) to develop technologies for drying apricots in Tajikistan (2017-2019).

Extension

Dr. Hirst works with the tree fruit industry to help them adapt to changing times. This includes new varieties and rootstocks, growing systems, marketing systems, legislative changes and decreasing labor availability. He achieves his extension goals by organizing and resourcing extension programs, the Facts for Fancy Fruit newsletter, one-to-one communication with growers and is Chair of the Indiana Horticultural Congress. Changes made in the industry as a result of Hirst’s extension program benefit the Indiana apple industry by over \$9 m annually. Highlights include:

- Editor of Facts for Fancy Fruit newsletter (www.hort.purdue.edu/fff)
- Chair, Indiana Horticultural Congress, 2003-2019 (www.inhortcongress.org)
- Invited speaker at state meetings in Idaho, Illinois, Kentucky, Michigan, Missouri, Ohio, Pennsylvania, Washington, Wisconsin.
- Conducted international workshops or presentations in Canada, China, Egypt, New Zealand, Australia, Mexico, and Zambia.

Research

Dr. Hirst’s research program addresses the needs of growers by focusing on finding solutions to immediate problems while also conducting longer term mechanistic studies that aim to further our knowledge of basic processes. His three areas of focus are apple flower formation, fruit development and tree architecture and automation. To conduct this research he collaborates with molecular biologists, bioinformaticians, engineers, industrial developers, computer graphic modelers, economists and sociologists. Hirst has been invited to present his research to many national and international audiences. His research has been funded through competitive federal, state and industry

grants (total approx. \$7.0 m). He currently supervises 5 researchers including graduate students and an undergraduate student.

Teaching

Dr. Hirst co-teaches HORT 301 (Plant Physiology) annually with Dr. Y. Li. This is an upper level under-graduate course attracting students from all plant-based disciplines across the College of Agriculture. Previously, he taught HORT 42100/41300 (Fruit Production)(1997-2016) with Dr. B. Bordelon (2008-2016). Dr. Hirst has received outstanding teaching evaluations from the students in this class and is an active guest lecturer, having given over 35 guest lectures.

Peer-reviewed publications

1. Elsysis, M.A., and P.M. Hirst. 2019. Molecular basis of flower formation in apple caused by defoliation and gibberellins. *J. Amer. Soc. Hort. Sci.* 144. In press.
2. Elsysis, M.A., M.V. Mickelbart and P.M. Hirst. 2019. Effect of fruiting and biennial bearing potential on spur quality and leaf gas exchange in apple. *J. Amer. Soc. Hort. Sci.* 144(1):31-37.
3. Ao Y., P.M. Hirst, G. Li, Y. Miao and R. Zhang. 2018. Combined effects of provenance and slow-release fertilizer on nursery and field performance of yellowhorn seedlings. *Silva Fennica* 52(5) article id 10034. 17 p.
<https://doi.org/10.14214/sf.10034>
4. Jahed, K. and P.M. Hirst. 2018. Pollen source effects on seed number, fruit quality and return bloom of apple. *J. Amer. Pomol. Soc.* 72(4):212-221.
5. Elsysis, M.A. and P.M. Hirst. 2017. The role of spur leaves, bourse leaves, and fruit on local flower formation in apple: an approach to understanding biennial bearing. *HortScience* 52(9):1229-1232.
6. Jahed, K. and P.M. Hirst. 2017. Pollen tube growth and fruit set in apple. *HortScience* 52(8):1054-1059.
7. Marshall-Colon, A., S.P. Long, D.K. Allen, G. Allen, D.A. Beard, B. Benes, S. von Caemmerer, A.J. Christensen, D.J. Cox, J.C. Hart, P.M. Hirst, K. Kannan, D.S. Katz, J.P. Lynch, A.J. Millar, B. Panneerselvam, N.D. Price, P. Prusinkiewicz, D. Ralla, R.G. Shekar, S. Shrivastava, D. Shukla, V. Srinivasan, M. Stitt, M.J. Turk, E.O. Volt, Y. Wang, X. Yin and X.G. Zhu. 2017. Crops *in silico*: Generating virtual crops using an integrative and multi-scale modeling platform. *Frontiers in Plant Science* Vol. 8. doi: 10.3389/fpls.2017.00786
8. Fiser, M., J. Ravi, B. Benes, B. Shi and P. Hirst. 2017. IMaple: a source-sink developmental model for ‘Golden Delicious’ apple trees. *Acta Hort* 1160:51-59.

9. Kang, H., M. Fiser, B. Shi, F. Sheibani, P. Hirst and B. Benes. 2016. IMapple – Functional structural model of apple trees. *IEEE International Conference on Functional-Structural Plant Growth Modeling Simulation, Visualization and Applications* (FSPMA 2016). P 90-97.
10. Franzen, J.B. and P.M. Hirst 2016. Optimal pruning of apple and effects on tree architecture, productivity and fruit quality. *Acta Hort* 1130: 307-310.
11. Chandrasekar, V., M.F. San Martin-Gonzalez, P. Hirst and T.S. Ballard. 2015. Optimizing microwave-assisted extraction of phenolic antioxidants from Red Delicious and Jonathan apple. *J. Food Process Eng.* 38(6): 571-582.
12. Zhang, Q., M. Han, C. Song, X. Song, C. Zhao, H. Liu, P.M. Hirst and D. Zhang. 2014. Optimizing planting density for production of high-quality apple nursery stock in China. *N.Z. J. Crop and Hort. Sci.* 43:1-11.
13. Chun, I.J., W.W. Zheng, C. Choi, Y.Y. Song, I.K. Kwang and P. Hirst. 2012. Multiple applications of lime sulfur for fruit thinning of ‘Fuji’ and ‘Hongro’ apple trees. *J. Bio-Environ. Control* 21(4): 445-451.
14. Zheng, W.W., M.Y. Park, P. Hirst, T.M. Yoon and I.J. Chun. 2012. The accumulation of rare earth elements fertilizer and its subsequent effects on apple fruit quality at harvest and during storage. *J. Bio-Environ. Control* 21(4): 452-458.
15. Li, Y. P.M. Hirst, Y.Wan, Y. Liu, Q. Zhou, H. Gao, Y. Guo, Z. Zhao, L. Wang and M. Han. 2012. Resistance to *Marssonina coronaria* and *Alternaria alternata* apple pathotype in the major apple cultivars and rootstocks used in China. *Hort Science* 47:1-4.
16. Hoover, E, R. Marini, E. Tepe, W. Autio, A. R. Biggs, J. M. Clements, R. Crassweller, D. Foster, M. Foster, P. Hirst, D. Miller, M. Parker, G. Peck, J. Racsko, T. Robinson, and M. Warmund. 2012. eApples: A Case Study in Using eXtension.org to Increase Access to Research-Based Information. *Hort Technology* 22: 576-579.
17. Wan, Y., H. Gao, Z. Zhao, Y. Lu, L. Wang, J. Yuan, and P. Hirst. 2011. An Early Ripening Apple Cultivar 'Qinyang'. *HortScience* 46:660-661.
18. Robinson, T., D. Wolfe, J. Masabni, R. Andersen, A. Azarenko, J. Freer, G. Reighard. P. Hirst, R. Hayden and B. McCluskey. 2010. Performance of plum rootstocks with ‘Stanley’, ‘Valor’, ‘Veeblue’ and ‘Santa Rosa’ as the scions in the 1991 NC-140 multi-state plum trial. *J. Amer. Pom. Soc.* 64:173-182.
19. Malladi, A. and P.M. Hirst. 2010. Increase in fruit size of a spontaneous mutant of ‘Gala’ apple (*Malus x domestica* Borkh) is facilitated by altered cell production and enhanced cell size. *J. Exp. Bot.* 61: 3003-3013.

20. Masabni, J., R. Andersen, A. Azarenko, G. Brown, J. Freer, R. Hayden, P. Hirst, B. McCluskey, R. Perry, T. Robinson and D. Wolfe. 2007. Performance of plum rootstocks with 'Stanley', 'Valor', and 'Veeblue' as the scion in the 1990 NC-140 multi-state plum trial. *J. Amer. Pom. Soc.* 61: 196-207.
21. Reighard, G., R. Andersen, J. Anderson, W. Autio, T. Beckman, T. Baker, R. Belding, G. Brown, P. Byers, W. Cowgill, D. Deyton, E. Durner, A. Erb, D. Ferree, A. Gaus, R. Godin, R. Hayden, P. Hirst, S. Kadir, M. Kaps, H. Larsen, T. Lindstrom, N. Miles, F. Morrison, S. Myers, D. Ouelette, C. Rom, W. Shane, B. Taylor, K. Taylor, C. Walsh, and M. Warmund. 2007. Growth and yield of 'Redhaven' peach on nineteen rootstocks at twenty North American locations. *Acta Hort.* 732:271-278.
22. Marini, R.P., J.L. Andersen, W.R. Autio, B.H. Barritt, J.A. Cline, W.P. Cowgill, R.M. Crassweller, J.M. Garner, A. Gaus, R. Godin, G.M. Greene, C.R. Hampson, P.M. Hirst, M.M. Kushad, J. Masabni, E. Meilke, R. Moran, C.A. Mullins, M.L. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T.L. Robinson, C.R. Rom, T. Roper, J.R. Schupp, E. Stover. 2006. Performance of 'Gala' trees on 18 dwarfing rootstocks: ten-year summary of the 1994 NC-140 rootstock trial. *J. Amer. Pom. Soc.* 60(2): 69-83.
23. Marini, R.P., B.H. Barritt, G.R. Brown, J.A. Cline, W.P. Cowgill, R.M. Crassweller, P.A. Domoto, D.C. Ferree, J.M. Garner, G.M. Greene, C.R. Hampson, P.M. Hirst, M.M. Kushad, J. Masabni, E. Meilke, R. Moran, C.A. Mullins, M.L. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T.L. Robinson, C.R. Rom, T. Roper, J.R. Schupp, E. Stover. 2006. Performance of 'Gala' apple on four semi-dwarf rootstocks: a ten-year summary of the 1994 NC-140 rootstock trial. *J. Amer. Pom. Soc.* 60(2): 58-68.
24. Reighard, G.L., R. Andersen, J. Anderson, W. Autio, T. Beckman, T. Baker, R. Belding, G. Brown, P. Byers, W. Cowgill, D. Deyton, E. Durner, A. Erb, D. Ferree, A. Gaus, R. Godin, R. Hayden, P. Hirst, S. Kadir, M. Kaps, H. Larsen, T. Lindstrom, N. Miles, F. Morrison, S. Myers, D. Ouellette, C. Rom, W. Shane, B. Taylor, K. Taylor, C. Walsh, and M. Warmund. 2004. Eight-year performance of 19 peach rootstocks at 20 locations in North America. *J. Amer. Pom. Soc.* 58(4):174-202.
25. Robinson, T.L., L. Andersen, A. Azarenko, B.H. Barritt, G.R. Brown, J.A. Cline, R.M. Crassweller, P.A. Domoto, C. Embree, A. Fennell, D.C. Ferree, E. Garcia, A. Gaus, G.M. Greene, C.R. Hampson, P.M. Hirst, E. Hoover, S. Johnson, M.M. Kushad, R. Marini, R. Moran, C.A. Mullins, M.L. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, C.R. Rom, T. Roper, J.R. Schupp, E. Stover. 2004. Performance of Cornell-Geneva rootstocks across North America in multi-location NC-140 rootstock trials. *Acta Hort.* 658(1): 241-245.
26. Shupert, D., A.P. Smith, J. Janick, P.B. Goldsbrough and P.M. Hirst.* 2004. Segregation of scab resistance in three apple populations: molecular marker and phenotypic analysis. *HortScience* 39(6): 1183-1184.

27. Hoover, E., N. De Silva, S. McCartney and P. Hirst. 2004. Bud development and floral morphogenesis in four apple cultivars. *J. Hortic. Sci and Biotech.* 79: 981-984.
28. Robinson, T., L. Anderson, A. Azarenko, B. Barritt, T. Baugher, G. Brown, G. Couvillon, W. Cowgill, Jr., R. Crassweller, P. Domoto, C. Embree, A. Fennell, E. Garcia, A. Gaus, R. Granger, G. Greene, P. Hirst, E. Hoover, S. Johnson, M. Kushad, R. Moran, C. Mullins, S. Myers, R. Perry, C. Rom, J. Schupp, K. Taylor, M. Warmund, J. Warner, and D. Wolfe. 2003. Performance of Cornell-Geneva apple rootstocks with 'Liberty' as the scion in NC-140 trials across North America. *Acta Hort.* 662:521-530.
29. Hirst, Peter M. 2002. The apple fruitlet thinning response to carbaryl is unaffected by russet. *Hort Technology* 12(1): 75-77.
30. Autio, W.R., J.L. Anderson, J.A. Barden, G.R. Brown, R.M. Crassweller, P.A. Domoto, W.A. Erb, D.C. Ferree, A. Gaus, P.M. Hirst, C.A. Mullins, and J.R. Schupp. 2001. Performance of 'Golden Delicious', 'Jonagold', 'Empire', and 'Rome Beauty' apple trees on five rootstocks over ten years in the 1990 NC-140 apple cultivar/rootstock trial. *J. Amer. Pom. Soc.* 55(3):131-137.
31. Autio, W. R., J. L. Anderson, J. A. Barden, G. R. Brown, R. M. Crassweller, P. A. Domoto, A. Erb, D. C. Ferree, A. Gaus, P. M. Hirst, C. A. Mullins, and J. R. Schupp. 2001. Location affects performance of 'Golden Delicious', 'Jonagold', 'Empire', and 'Rome Beauty' apple trees on five rootstocks over ten years in the 1990 NC-140 cultivar/rootstock trial. *J. Amer. Pom. Soc.* 55(3):138-145.
32. Domoto, P.A., W.R. Autio, G.R. Brown, D.C. Ferree, P.M. Hirst, C.A. Mullins and J.R. Schupp. 2001. Blackheart injury in 'Golden Delicious', 'Jonagold', 'Empire', and 'Rome Beauty' apple trees on five rootstocks over ten years in the 1990 NC-140 cultivar/rootstock trial. *J. Amer. Pom. Soc.* 55(3):146-153.
33. Hirst, P.M., W.R. Autio, J.A. Barden, G.R. Brown, R.M. Crassweller, P.A. Domoto and J.R. Schupp. 2001. Performance of trees in the 1990 NC-140 cultivar/rootstock planting: additional cultivars and rootstocks. *J. Amer. Pom. Soc.* 55(3):178-184.
34. McCartney, S.J., E.M. Hoover, P.M. Hirst and I.R. Brooking. 2001. Seasonal variation in the onset and duration of flower development within apple buds cv. 'Royal Gala'. *J. Hort Sci and Biotech.* 76(4): 536-540.
35. Rieghard, G.L., J.L. Anderson, R. Anderson, W. Autio, T. Beckman, R. Belding, G. Brown, W. Cowgill, D. Deyton, E. Durner, A. Erb, A. Gaus, P. Hirst, M. Kaps, N. Miles, F. Morrison, S. Myers, R. Perry, C.R. Rom, W. Shane, B. Taylor, K. Taylor, C. Walsh, and M. Warmund. 2001. Five-year performance of 19 peach rootstocks at 20 sites in North America. *Acta Hort.* 557: 97-102.

36. Hirst, P.M. and NC-140 cooperators. 2001. Early performance of 'Gala' on 18 dwarf and 4 semi-dwarf rootstocks growing at 24 sites in North America. *Acta Hort.* 557: 199-205.
37. Autio, W.R., J.L. Anderson, J.A. Barden, G.R. Brown, R.M. Crassweller, L.D. Tukey, P.A. Domoto, W.A. Erb, F. Morrison, D.C. Ferree, A. Gaus, P.M. Hirst, R.A. Hayden, C.A. Mullins, J.R. Schupp. 2001. Rootstock and scion interact to affect apple tree performance: results from the 1990 NC-140 cultivar/rootstock trial. *Acta Hort.* 557: 41-46.
38. Marini, R.P., J.L. Anderson, B.H. Barritt, G.R. Brown, J.A. Cline, W.P. Cowgill, P.A. Domoto, D.C. Ferree, J.M. Garner, G.M. Greene, C.R. Hampson, P.M. Hirst, M.M. Kushad, E. Meilke, C.A. Mullins, M.L. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T.L. Robinson, C.R. Rom, T. Roper, J.R. Schupp, E. Stover, and C.R. Unrath. 2000. Performance of 'Gala' on four semi-dwarf rootstocks: Five-year summary of the 1994 NC-140 semi-dwarf rootstock trial. *J. Amer. Pom. Soc.* 54(2):84-91.
39. Marini, R.P., J.L. Anderson, B.H. W.R. Autio, Barritt, J.A. Cline, W.P. Cowgill, R.M. Crassweller, P.A. Domoto, D.C. Ferree, J.M. Garner, A. Gaus, G.M. Greene, C.R. Hampson, P.M. Hirst, M.M. Kushad, E. Meilke, C.A. Mullins, M.L. Parker, R.L. Perry, J.P. Privé, G.L. Reighard, T.L. Robinson, C.R. Rom, T. Roper, J.R. Schupp, E. Stover, C.R. Unrath. 2000. Performance of 'Gala' on 18 dwarf rootstocks: Five-year summary of the 1994 NC-140 semi-dwarf rootstock trial. 2000. *J. Amer. Pom. Soc.* 54(2):92-107.
40. Hirst, P.M. and R.R. Flowers. 2000. Rootstock effects on growth and cell size of 'Gala' apple fruit. *Acta Hort.* 517:189-194.
41. Jung, K.H., R. Stroshine, P. Cornillon and P.M. Hirst. 1998. Low field proton magnetic resonance sensing of water core and internal browning in whole apples. Paper 98-6020. ASAE, St. Joseph, MI.
42. Hirst, P.M. and D.C. Ferree. 1996. Effects of rootstock on bud development and flower formation of 'Starkspur Supreme Delicious' apple. *Fruit Var. J.* 50(1):25-34.
43. Warrington, I.J., C.J. Stanley, D.S. Tustin, P.M. Hirst and W.M. Cashmore. 1996. Light transmission, yield distribution, and fruit quality in six tree canopy forms of 'Granny Smith' apple. *J. Tree Fruit Prod.* 1 (1):27-54.
44. Ferree, D.C., P.M. Hirst, J.C. Schmid, and P.E. Dotson. 1995. Performance of three apple cultivars with 22 dwarfing rootstocks during 8 seasons in Ohio. *Fruit. Var. J.* 49(3):171-178.

45. Hirst, P.M. and D.C. Ferree. 1995. Effect of rootstock and cultivar on the growth and precocity of young apple trees. *Fruit Var. J.* 49(1):34-41.
46. Hirst, P.M. and D.C. Ferree. 1995. Rootstock effects on shoot morphology and spur quality of 'Delicious' apple and relationships with precocity and productivity. *J. Amer. Soc. Hort. Sci.* 120(4):622-634.
47. Hirst, P.M. and D.C. Ferree. 1995. Rootstock effects on the flowering of 'Delicious' apple. I. Bud development. *J. Amer. Soc. Hort. Sci.* 120(6):1010-1017.
48. Hirst, P.M. and D.C. Ferree. 1995. Rootstock effects on the flowering of 'Delicious' apple. II. Nutritional effects with special reference to phosphorous. *J. Amer. Soc. Hort. Sci.* 120(6): 1018-1024.
49. Warrington, I.J., C.J. Stanley, J.F. Julian, D.S. Tustin, P.M. Hirst and W.M. Cashmore. 1995. Pruning strategies for restructuring top-dominant central leader 'Granny Smith' apple trees. *N.Z. J. Crop. Hort. Sci.* 23:315-322.
50. Tustin, D.S., P.M. Hirst, W.M. Cashmore, I.J. Warrington and C.J. Stanley. 1992. Spacing and rootstock studies with central leader apple canopies in a high vigour environment. *Acta Hort.* 349: 169-178.
51. Hirst, P.M., D.S. Tustin and I.J. Warrington. 1990. Fruit colour responses of 'Granny Smith' apple to variable light environments. *N.Z. J. Crop and Hort. Sci* 18:205-214.
52. Tustin, D.S., P.M. Hirst, I.J. Warrington and C.J. Stanley. 1989. Light distribution and fruit quality through multi-layered trellis apple canopies. *Acta Hort.* 243:209-212.
53. Tustin, D.S., P.M. Hirst, and I.J. Warrington. 1988. Influence of orientation and position of fruiting laterals on canopy light penetration, yield and fruit quality of 'Granny Smith' apple. *J. Amer. Soc. Hort. Sci.* 113(5):693-699.

Book Chapters published

Hirst, P.M. 2003. Flower bud formation, pollination and fruit set. *In: Concise Encyclopedia of Temperate Zone Tree Fruits.* Eds: T.A. Baugher and S. Singha. Hawthorn Press, New York.

Hirst, P.M. 2017. Advances in understanding flowering and pollination in apple trees. *In: Achieving sustainable cultivation of apples.* Ed: K. Evans. Burleigh Dodds Science Publishing, Cambridge, UK.