

## CURRICULUM VITAE

Raphael Abraham Stern

January, 2024

**PERSONAL**

Born: 1951, Israel.

Marital status: Married + 5

Army service: 1969-72

Work address: MIGAL, Galilee Technology Center, P.O. Box 831, Kiryat-Shmona 11016, Israel and the Department of Biotechnology, Faculty of Life Sciences, Tel-Hai College, Upper Galilee 12210, Israel.

Phone numbers: Work- 04-6953532 Cell. 050-5680126

E-mail address: Raffi@migal.org.il

**UNIVERSITY EDUCATION**

1975-1977 B.Sc. in Agriculture, at the Hebrew University of Jerusalem.

1978-1979 M.Sc. in Horticulture, at the Hebrew University of Jerusalem.  
Title of thesis: **“Improving rooting and viability of rooted peach cuttings under mist.”**  
Supervisors: Profs. A. Gur & A. Altman, Dept. Horticulture.

1988-1992 Ph.D. in Horticulture, at the Hebrew University of Jerusalem.  
Title of thesis: **“Factors affecting litchi productivity in Israel and development of methods to improve its yields.”**  
Supervisors: Profs. S. Gazit, J. Kigel & Dr. I. Adato, Dept. Horticulture.

**FURTHER STUDIES**

1993 Post-Doctoral training scholarship in USA, Puerto Rico & Ecuador. (Baron de Hirsch Fund).

1995-1996 Post- Doctoral Research Associate at the Hebrew University of Jerusalem, with Prof. O. Shuseiov.  
Research subject: **“Isolation and identification of RNase gene from Starking apple.”**

## **POSITIONS HELD AND ACADEMIC STATUS**

1972-1979	Horticulturist in Kibbutz Lavi orchards.
1979-1987	Manager of the Kibbutz Lavi orchards (avocado, pears, olives, litchi and grapes), and participated in experimental projects with researchers from the Volcani Center, ARO, on plant protection, dormancy break, olive harvesting machinery, irrigation, fertilization and pruning.
1982-2000	Established and managed experimental plots of mango, litchi macadamia and fejoa at Kibbutz Lavi together with the Horticultural Department of Volcani Center (ARO).
1982-1992	Member in the Regional Boards for Pear and Avocado.
1984-1994	Member in the National Board for Pears.
1989-1998	Member in the National Litchi Board, as expert on litchi.
1997-2004	Member in a steering committee for Matityahu Research Station, Nomination by the Volcani Center (ARO).
1998-2001	Member of scientific management in the Bureau of Chief Scientist in the Ministry of Agriculture for litchi and mango.
2000-2006	Member of scientific management in the Bureau of Chief Scientist in the Ministry of Agriculture for Israeli biblical fruits (grape, fig, olive, pomegranate, date and almond).
1988-1992	Research Assistant in the Department of Horticulture of the Faculty of Agriculture in Rehovot.
1993	Scientist at MIGAL (Grade C)
1993 to date	Regional Researcher (deciduous and litchi) for north of Israel at MIGAL and Northern R&D.
2000-2004	Senior Scientist (Grade B) at MIGAL [Senior lecturer]
2004- 2008	Associate Principal Scientist (Grade A) at MIGAL [Associate Prof.]
2008 to date	Principal Scientist (Grade A+) at MIGAL [Professor]
2008 to date	Member of Scientific Management in the Bureau of chief scientist in the Ministry of Agriculture for "Global Warming".
2008-2010	Member of Scientific Management in the Bureau of chief scientist in the Ministry of Agriculture for "Colony Collapse Disorder" (CCD).

2009- 2012	Member of Scientific Management in the Bureau of chief scientist in the Ministry of Agriculture for "Fruit Trees – Long Term Program".
2010 to date	Tel-Hai College, Head of Agricultural Cluster, the Department of Biotechnology.
2012-2014	Member of Scientific Committee at MIGAL
2012-	Excellent lecturer at Tel-Hai College
2012-	Associate Prof. of Plant Science (Horticulture)
2013-2015	Chairman of Scientific Committee in the Bureau of chief scientist in the Ministry of Agriculture for "Whole Plant Science".
2016 to date	Member of Scientific Committee in the Bureau of chief scientist in the Ministry of Agriculture for "Citrus – Fruit Trees".
2017-	Full Prof. of Plant Science (Horticulture)
2017-	Excellent lecturer at Tel-Hai College

### **SPECIAL INVITATIONS**

1996-	Invited by Spanish Ministry of Agriculture as advisor on cultivation of litchi (South Spain).
1998- (Summer)	Invited by Chinese Ministry Foreign Experts as advisor on litchi cultivation (Guangxi Province).
1999- (Summer)	Invited by Chinese Ministry Foreign Experts as advisor on litchi cultivation (Guangxi Province).
2000- (Summer)	Invited by Chinese Ministry Foreign Experts as advisor on litchi cultivation (Guangxi Province).
2022-(May)	Invited by India Ministry of Agriculture as advisor on pollination of fruit trees.
2022-(June)	Invited by Spanish avocado growers as advisor on avocado and litchi pollination.

### **PROFESSIONAL STUDY TOURS**

1998- (Summer)	Professional tour to study the Pear Industry (Cultivation and Research) in Spain (Lleida/Barcelona).
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- 1999- (Summer) Professional tour to study the Pear and Apple research in Bologna University (Italy), INRA research station at Angers (France) and CTIFL station at Bordoux (France).
- 2001- (Winter) Professional tour to study the New Zealand R&D systems in deciduous.
- 2003- (Summer) Professional tour to study the Pear research and industry in Portugal and Italy.
- 2004- (Winter) Professional tour to study the lychee research and industry in South Africa.
- 2004- (Summer) Professional tour to study the peach research and industry in south Italy.
- 2005- (Summer) Professional tour to study the cherry research and industry in Turkey.
- 2006- (Winter) Professional tour to study the Chile R&D systems in deciduous.
- 2009- (Summer) Professional tour to study the Pear rootstocks and plantation systems in Italy (Bologna) and Spain (Lieida).
- 2011- (Summer) Professional tour to study the new Poem and Stone fruit cultivars in Italy (Ferrara) and France (Provance).

### **TEACHING AND TRAINING EXPERIENCE**

1. Lecturer, Graduate course on Botany (Course # 1021204) at Tel-Hai Academic College (Biotechnology Sciences) from 2003 to 2007.
2. Lecturer, Graduate course on Modern Agriculture (Course # 1011601), Tree Biology (Course # 1400012), Biology of Deciduous Fruit Trees (Course # 1400022), Biology of Tropical and Subtropical Fruit Trees (Course # 1400044) at Tel-Hai College (Agricultural Sciences) from 2009 to date.
3. Lecturer, on Botany in a course for wine industry (Cellar Master) and olive oil industry at Tel-Hai Academic College from 2004 to date.
4. Lecturer, international course for foreign students (Agrostudy) "Biology of Subtropical Fruit Trees" at Tel-Hai College from 2011 to date.
5. Lecturer, basic course on "Plant bioregulators: Principle and Applications", at the Extension Service of the Ministry of Agriculture from 1998 to date.

6. Lecturer, Annual Meetings on “Pollination in Agricultural Crops” at the Volcani Center (1993 – lychee, 1995 – lychee, 1998 – apple, 2007 – deciduous).
7. Lecturer, Annual Meetings on “Lychee Productivity”, at the Extension Service of the Ministry of Agriculture (1990-2000).
8. Lecturer, Annual Meetings on “Apple and Pear Cultivation”, at the Extension Service of the Ministry of Agriculture from 1997 to date.
9. Students: Arnon Dag, Post-Doctoral stage (1999-2000); Doron Schneider, PhD (1998-2002); Gal Sapir, MSc (2001-2002) and PhD (2003-2007); Anat Zisovich, MSc (with excellence 2002-2003) and PhD (2007-2012), Amir Raz, MSc (2005-2007) and PhD (2007- 2015), Zlil Baras MSc (2011-2014), Paulo Stal, MSc (2012-2015), Eytan Shimshovich, MSc (2013-2016), Yael Lev, MSc (2014-2018), Guy Azmon MSc (2014-2016), Lilach Shifman, MSc (2016-2018), Rita Mondar, MSc (2017-2020), Lior Cohen, MSc (2017-2020), Dafna Tidhar, MSc (2018-2021), Opal Bechar (2021-2023), Michal Akerman, Post-Doctoral stage (2021-2023), Rona Biber (2021-2023), Tal Kupper, MSc (2022- ), Roi Golan, MSc (2023- ).
10. Secondary School Students: About 15 research studies (Final Projects) at the Sde-Eliyahu Regional School (Bet Shean Vally) and at schools in the Upper Galilee through the Association for the Advancement of Science Education in Galilee.

### **PRIZES / AWARDS**

2008: 10,000\$ from the JCA charitable foundation for outstanding contribution to the development by unique, innovation and entrepreneurial projects (pollination and fertilization in Deciduous fruit).

2016: Received the honor of "Notable" of the Israeli Fruit Grower Association

### **PARTICIPATION IN INTERNATIONAL SEMINARS/MEETINGS**

1992 International Congress on Horticulture, Honolulu, Hawaii, USA.

1992 International Symposium on Orchard and Plantation System, Israel.

1995 International Congress on Avocado. Israel.

1996 International Congress on Mango. Israel.

2000 International Symposium on litchi and longan, Guangzhou, China.

2000 International Symposium on pear growing, Bologna, Italy.

- 2002 International Congress on Horticulture (26<sup>th</sup>), Toronto, Canada.
- 2004 International Symposium on pear growing, Stellenbosch, South Africa.
- 2005 International Symposium on cherry growing, Bursa, Turkey.
- 2006 International Symposium on kiwifruit growing, Rotorua, New Zealand.
- 2006 International Congress on Horticulture (27<sup>th</sup>), Seoul, Korea
- 2007 International Symposium on pear growing, Peniche, Portugal.
- 2007 International “Brainstorm” on fruit and vegetable for Africa, Nairobi, Kenya.
- 2008 International Symposium on rootstock physiology, Geneva, N.Y. USA.
- 2009 International Symposium on cherry growing, Renaca, Chile.
- 2011 International Congress on Horticulture, Waikaloa, Hawaii, USA
- 2012 International Symposium on plant reproduction biology. Pecs, Hungary.
- 2013 European Working Group on Fruit Thinning (EUFRIN), Lisbon, Portugal.
- 2013 International Symposium on cherry growing, Plasencia, Spain.
- 2014 European Working Group on Fruit Thinning (EUFRIN), Einsiedeln, Switzerland.
- 2014 International Congress on Horticulture (29<sup>th</sup>), Brisbane, Australia. (Keynote Lecture)
- 2015 International Workshop on Alternate Bearing, Rehovot, Israel.
- 2016 International Workshop on Floral Biology in Fruit Species, Murcia, Spain.
- 2016 International Symposium on “Integrating Canopy, Rootstock and Environmental Physiology in Orchard Systems”, Bologna, Italy. August-September 2016.
- 2017 International Symposium on “Plant Growth Regulators in plants”, Tokyo, Japan.
- 2018 International Symposium on “Beneficial Expressions of Insects”, Afula, Israel. (Keynote)
- 2018 International Symposium on pear growing, Montevideo, Uruguay.
- 2022 National conference on bee keeping and pollination. Ramnagar, Haryana, India. May 20-21, 2022 (Keynote Lecture).
- 2023 European Working Group on Fruit Thinning (EUFRIN), Kfar Giladi, Israel. February 21-25, 2023.
- 2023 International Symposium on Pollination (ICPPR#12), Cape Town, South Africa. October 15-20, 2023.

## **MEMBER OF THE SCIENTIFIC COMMITTEE FOR INTERNATIONAL SEMINARS**

- 2007 International symposium on pear growing, Peniche, Portugal  
2014 International symposium on tropical fruit, Brisbane, Australia.

## **MEMBERSHIP IN INTERNATIONAL SOCIETIES**

- 1991-2013 American Society for Horticultural Science (ASHS).  
1992 to date International Society for Horticultural Science (ISHS).

## **EDITORIAL RESPONSIBILITIES**

- 1995 to date Reviewer of manuscripts for international refereed journals on Plant Science: Journal of the American Society for Horticultural Science, HortScience, Journal of Horticultural Science and Biotechnology, Scientia Horticulturae, Australian Journal of Agricultural Research, Australian Journal of Experimental Agriculture, Brazilian Journal of Plant Physiology, New Zealand Journal of Crop and Horticultural Science, Horticultural Reviews, Plant Cell Reports, Agricultural Water Management, Plants, Agronomy, Horticulture.
- 1997 to date Reviewer for granting agencies:
1. US-IS Binational Agricultural Research and Development Fund (BARD).
  2. German-Israel Foundation for Scientific Research and Development (GIF).
  3. Israel Ministry of Agriculture.
  4. Israel Ministry of Science.
- 2010 to 2014 Associate Editor of "The Journal of Horticultural Science & Biotechnology".

**RESEARCH COMPETITIVE GRANTS**

- 1988- Chief Scientist of the Ministry of Agriculture.  
Title: Factors affecting litchi productivity.  
Budget: 40,000 \$/ year; 3 years, with S. Gazit as P.I. Researcher's part:  
30,000\$/ year.
- 1991- Chief Scientist of the Ministry of Agriculture.  
Title: Factors affecting litchi productivity.  
Budget: 40,000 \$/ year; 3 years, with S. Gazit as P.I. Researcher's part:  
30,000\$/ year.
- 1993- Chief Scientist of the Ministry of Agriculture.  
Title: Factors affecting litchi productivity.  
Budget: 35,000 \$/ year; 3 years, with S. Gazit as P.I. Researcher's part:  
35,000\$/ year.
- 1994- Chief Scientist of the Ministry of Agriculture.  
Title: Litchi fertility.  
Budget: 18,000\$/ year; 1 year, P.I. Researcher's part: 18,000\$.
- 1995- Chief Scientist of the Ministry of Agriculture.  
Title: Autumnal water stress in litchi.  
Budget: 30,000\$/ year; 3 years, P.I. Researcher's part: 24,000\$/ year.
- 1996- Chief Scientist of the Ministry of Agriculture.  
Title: Factors affecting litchi productivity.  
Budget: 30,000 \$/ year; 3 years, with S. Gazit as P.I. Researcher's part:  
30,000\$/ year.
- 1998- Chief Scientist of the Ministry of Agriculture.  
Title: Reduction of biennial bearing and improving the productivity of the  
apple Red-Delicious.  
Budget: 38,000\$/ year; 3 years, with A. Erez as P.I. Researcher's part:  
25,000\$/ year.
- 1999- Chief Scientist of the Ministry of Agriculture.  
Title: Improving fruit size of apple and pear.  
Budget: 50,000\$/ year; 3 years, P.I. Researcher's part: 35,000\$/ year.
- 1999- The Ministry of Science and Technology of Israel.  
Title: Identification of better pollenizers for Starking Delicious apple.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 1999- Chief Scientist of the Ministry of Agriculture.



- Title: New rootstocks and varieties for pears.  
Budget: 35,000\$/ year; 3 years, P.I. Researcher's part: 35,000\$/ year.
- 2000- Chief Scientist of the Ministry of Agriculture.  
Title: Searching for the best pollenizer for Starking Delicious yield.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2000- Chief Scientist of the Ministry of Agriculture.  
Title: Raising yield and fruit size in litchi and bringing ripening forward by advancing blossoming, improving fruit set and reducing drop.  
Budget: 22,000\$/ year; 3 years, with I. Adato as P.I. Researcher's part: 10,000\$/ year.
- 2001- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing yield of Japanese plum in Israel by determining genetic fit between male and female varieties by molecular techniques.  
Budget: 35,000\$/ year; 3 years, P.I. Researcher's part: 35,000\$/ year.
- 2001- Chief Scientist of the Ministry of Agriculture.  
Title: The effect of post harvest irrigation rate on autumnal flowering in pear and tree performance in the following year.  
Budget: 22,000\$/ year; 3 years, with A. Naor as P.I. Researcher's part: 5,000\$/ year.
- 2001- Chief Scientist of the Ministry of Agriculture.  
Title: Improving water absorption capacity of deciduous trees grown on heavy soils by changing irrigation regime and improving soil structure.  
Budget: 25,000\$/ year; 3 years, with A. Naor as P.I. Researcher's part: 5,000\$/ year.
- 2002- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing yield of pear by improving cross-pollination and determining genetic compatibility between varieties.  
Budget: 28,000\$/ year; 3 years, P.I. Researcher's part: 24,000\$/ year.
- 2002- Chief Scientist of the Ministry of Agriculture.  
Title: Improving fruit size of apple and Japanese plum.  
Budget: 30,000\$/ year; 3 years, P.I. Researcher's part: 25,000\$/ year.
- 2002- Chief Scientist of the Ministry of Agriculture.  
Title: New rootstocks and varieties for pears.  
Budget: 25,000\$/ year; 3 years, P.I. Researcher's part: 25,000\$/ year.
- 2002- Chief Scientist of the Ministry of Agriculture.

- Title: Assessment of the color-net technology for improve productivity and fruit quality in apple.  
Budget: 30,000\$/ year; 2 years, with Y. Shahak as P.I. Researcher's part: 7,000\$/ year.
- 2003- Chief Scientist of the Ministry of Agriculture.  
Title: Improving size of apricot and cherry.  
Budget: 30,000\$/ year; 3 years, P.I. Researcher's part: 30,000\$/ year.
- 2003- Chief Scientist of the Ministry of Agriculture.  
Title: The effect of shade nets on water consumption, fruit quality and microclimate in apple orchards.  
Budget: 30,000\$/ year; 3 years, with J. Tanny as P.I. Researcher's part: 5000\$/ year.
- 2004- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing yield of Japanese plum in Israel by improving pollination and fertilization and by determining genetic fit between male and female varieties.  
Budget: 25,000\$/ year; 2 years, P.I. Researcher's part: 25,000\$/ year.
- 2004- Chief Scientist of the Ministry of Agriculture.  
Title: Assessment of the color-net technology to improve productivity and fruit quality in apple.  
Budget: 25,000\$/ year; 3 years, with Y. Shahak as P.I. Researcher's part: 5,000\$/ year.
- 2005- Chief Scientist of the Ministry of Agriculture.  
Title: Development of alternative methods for hand thinning of peach and nectarine in order to reduce costs and to improve export potential.  
Budget: 20,000\$/ year; 3 years, P.I. Researcher's part: 20,000\$/ year.
- 2005- Chief Scientist of the Ministry of Agriculture.  
Title: Assessment of color-net technology to improve productivity and fruit quality in pears.  
Budget: 30,000\$/ year; 3 years, with Y. Shahak as P.I. Researcher's part: 7,000\$/ year.
- 2006- ICA.  
Title: Using microbiology technologies for overcoming fertility and quality constrains in deciduous tree plantation in northern Israel.  
Budget: 100,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2006- Chief Scientist of the Ministry of Agriculture.

- Title: Using Methyl Jasmonate as a means for improving red color in apple.  
Budget: 25,000\$/ year; 3 years with Y. Cohen as P.I. Researcher's part:  
7,000\$/ year.
- 2006- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing yield of Japanese plum and apricot, by improving pollination and fertilization and by determining genetic fit between male and female varieties.  
Budget: 20,000\$/ year; 3 years, P.I. Researcher's part: 20,000\$/ year.
- 2006- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing fertility and fruit size of 'Spadona' pear by controlling the vegetative growth.  
Budget: 20,000\$/ year; 3 years, P.I. Researcher's part: 20,000\$/ year.
- 2006- Market oriented R&D.  
Title: Development of new methods for increasing the export potential of stone fruit.  
Budget: 100,000\$/ year; 2 years, with M. Flaishman as P.I. Researcher's part:  
10,000\$/ year.
- 2007- Chief Scientist of the Ministry of Agriculture.  
Title: Increasing fertility and fruit size of 'Spadona' and 'Coscia' pear by improving pollination and fertilization with better pollinators (Bumble bee) and pollenizers (new cultivars).  
Budget: 30,000\$/ year; 3 years, P.I. Researcher's part: 30,000\$/ year.
- 2007- Horticultural Board.  
Title: Development of alternative methods for hand thinning of cherry in order to increase fruit size and reduce costs.  
Budget: 10,000\$/ year; 3 years, P.I. Researcher's part: 10,000\$/ year.
- 2008 - Chief Scientist of the Ministry of Agriculture.  
Title: Development of alternative methods for hand thinning of Japanese plum and apricot in order to increase fruit size and reduce costs.  
Budget: 25,000\$/ year; 3 years, P.I. Researcher's part: 25,000\$/ year.
- 2009 - Chief Scientist of the Ministry of Agriculture.  
Title: Response of Deciduous orchards to multiple season severe water stress – physiology, horticultural and practical implications.  
Budget: 80,000\$/ year; 3 years, with A. Naor as P.I. Researcher's part:  
15,000\$/ year.

- 2009 - Chief Scientist of the Ministry of Agriculture.  
 Title: Development of alternative methods for hand thinning of cherry in order to increase fruit size and reduce costs.  
 Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2010 - Chief Scientist of the Ministry of Agriculture.  
 Title: Increasing fertility and fruit size of Delicious, Golden Delicious and Gala apple by controlling the vegetative growth.  
 Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2011 - Horticultural Board and Chief Scientist of the Ministry of Agriculture  
 Title: Increasing fertility and fruit size of Delicious and Golden Delicious apple by improving pollination and fertilization with Bumble bees and better pollenizers.  
 Budget: 30,000\$/ year; 3 years, P.I. Researcher's part: 30,000\$/ year.
- 2011 - Horticultural Board.  
 Title: Reducing calyx-end cracking of 'Pink Lady' apple fruit.  
 Budget: 10,000\$/ year; 3 years, P.I. Researcher's part: 10,000\$/ year.
- 2011 - Chief Scientist of the Ministry of Agriculture.  
 Title: Evaluation of new training systems for the pear to reduce labor inputs and improve fruit quality.  
 Budget: 45,000\$/ year; 6 years, P.I. Researcher's part: 45,000\$/ year.
- 2011 - Chief Scientist of the Ministry of Agriculture.  
 Title: Development of alternative methods for hand thinning of Stone fruits and Loquat.  
 Budget: 50,000\$/ year; 3 years, P.I. Researcher's part: 50,000\$/ year.
- 2011 - The Ministry of Science and Technology of Israel.  
 Title: Infection process and rot production by *Alternaria mali* in apple fruit and development of disease control management.  
 Budget: 33,000\$/ year; 3 years with M. Reuveni as P.I. Researcher's part: 10,000\$/ year.
- 2011 - Horticultural Board (Ministry of Agriculture Project) #596-0462-11  
 Title: Development of chemical thinning for apple and pear.  
 Budget: 45,000\$/ year; 3 years, P.I. Researcher's part: 45,000\$/ year.
- 2011 - Horticultural Board (Ministry of Agriculture Project) #596-0474-11  
 Title: New rootstocks and varieties for deciduous fruit trees.  
 Budget: 55,000\$/ year; 3 years, P.I. Researcher's part: 55,000\$/ year.

- 2011 - Horticultural Board (Ministry of Agriculture Project) #596-0473-11  
Title: Improve the cultivation of Pink Lady apple fruit.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2013 - Chief Scientist of the Ministry of Agriculture.  
Title: Development of a DSS system for apple trees thinning based on precision agriculture principles.  
Budget: 120,000\$/ year; 3 year with V. Elchanati as P.I. Researcher's part: 30,000\$/ year.
- 2013 - Horticultural Board (Ministry of Agriculture Project) #596-0531-13  
Title: Evaluation of high density plantation of pear trees in order to reduce the incidence of fire blight disease.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2014 - Chief Scientist of the Ministry of Agriculture.  
Title: Introduction of deciduous fruit trees under local condition.  
Budget: 35,000\$/ year; 3 year, P.I. Researcher's part: 35,000\$/ year.
- 2014 - Chief Scientist of the Ministry of Agriculture.  
Title: Identification and development of cyanamid substitute for dormancy release in deciduous fruit trees.  
Budget: 32,000\$/ year; 3 year, P.I. Researcher's part: 32,000\$/ year (+ matching from Horticultural Board of the same budget as above).
- 2014 - Horticultural Board (Ministry of Agriculture Project) #596-0565-14  
Title: Development of alternative methods for hand thinning of stone fruit.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2014 - Horticultural Board (Ministry of Agriculture Project) #596-0575-14  
Title: Development of chemical thinning for apple and pear.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.
- 2014 - Horticultural Board (Ministry of Agriculture Project) #596-0574-14  
Title: Increasing pollination of apple and pear by adding bumble bees to the orchards.  
Budget: 30,000\$/ year; 3 years, with G. Sapir as P.I. Researcher's part: 20,000\$/ year.
- 2014 - Horticultural Board (Ministry of Agriculture Project) #596-xxx-14  
Title: Introduction of new rootstocks for deciduous fruit trees under local conditions.  
Budget: 40,000\$/ year; 3 years, P.I. Researcher's part: 40,000\$/ year.

- 2014 - Horticultural Board (Ministry of Agriculture Project) #596-xxx-14  
 Title: The use of geothermic water to heat fruit trees in greenhouses for early marketing.  
 Budget: 60,000\$/ year; 3 years, with A. Naor as P.I. Researcher's part: 10,000\$/ year.
- 2015 - Horticultural Board (Ministry of Agriculture Project)  
 Title: Reduce cracking in Pink Lady apple fruit.  
 Budget: 20,000\$/ year; 3 years, P.I. Researcher's part: 20,000\$/ year.
- 2015 - Chief Scientist of the Ministry of Agriculture.  
 Title: Model plots in deciduous orchards in the Western Galilee to promote the implementation of new horticultural technology.  
 Budget: 100,000\$/ year; 3 year, with A. Naor as P.I. Researcher's part: 20,000\$/ year.
- 2015 - Horticultural Board (Ministry of Agriculture Project)  
 Title: 'Mauritius' litchi productivity and development new growth technologies to improve cultivation of early and late litchi cultivars.  
 Budget: 15,000\$/ year; 3 years, P.I. Researcher's part: 15,000\$/ year.
- 2016 - Chief Scientist of the Ministry of Agriculture.  
 Title: Increasing 'Mauritius' litchi productivity and development new growth technologies to improve cultivation of early and late litchi cultivars.  
 Budget: 30,000\$/ year; 3 year, P.I. Researcher's part: 30,000\$/ year.
- 2016 - Chief Scientist of the Ministry of Agriculture.  
 Title: New strategies for inhibiting litchi pericarp disorders after harvest.  
 Budget: 110,000\$/ year; 3 year, with S. Harpaz as P.I. Researcher's part: 5,000\$/ year.
- 2016 - Chief Scientist of the Ministry of Agriculture.  
 Title: Evaluation and development of apple replanting tolerant rootstocks.  
 Budget: 35,000\$/ year; 3 year, with N. Galpaz as P.I. Researcher's part: 5,000\$/ year.
- 2016 - MIGAL  
 Title: Developing a non-GM self fertile apple cultivar using the CRISPR/Cas transformation system.  
 Budget: 25,000\$/ year; 3 year, with M. Goldway as P.I. Researcher's part: 5,000\$/ year.
- 2017 - Chief Scientist of the Ministry of Agriculture.

- Title: Introduction of deciduous fruit trees under local condition.  
Budget: 35,000\$/ year; 6 year, P.I. Researcher's part: 35,000\$/ year.
- 2017- Horticultural Board (Ministry of Agriculture Project) #91-01-0005.  
Title: Evaluation of new dwarfing apple and pear rootstocks .  
Budget: 100,000\$/ year; 3 years, P.I. Researcher's part: 100,000\$/ year.
- 2017- Horticultural Board (Ministry of Agriculture Project) #91-01-0002.  
Title: Evaluation of new training system for the pear.  
Budget: 100,000\$/ year; 3 years, P.I. Researcher's part: 100,000\$/ year.
- 2017 – MIGAL – Tel Hai.  
Title: Development of functional and healthy superfood based on apple loss.  
Budget: 15,000\$/ year; 1 year, with O. Benjamin as P.I. Researcher's part: 5,000\$/ year.
- 2017 - Chief Scientist of the Ministry of Agriculture.  
Title: Applications of Plant Growth Regulators to Pink Lady apple in order to reduce cracking.  
Budget: 60,000\$/ year; 3 year, with I. Ginzberg as P.I. Researcher's part: 20,000\$/ year.
- 2017 - Chief Scientist of the Ministry of Agriculture.  
Title: Increasing fertility of Hass avocado using bumble bees.  
Budget: 40,000\$/ year; 3 year, P.I. Researcher's part: 40,000\$/ year.
- 2017 - Chief Scientist of the Ministry of Agriculture.  
Title: Late chemical thinning in apple based on prediction of future abscission using molecular markers.  
Budget: 60,000\$/ year; 4 year, with A. Samach as P.I. Researcher's part: 15,000\$/ year.
- 2018 - Chief Scientist of the Ministry of Agriculture.  
Title: Development of a DSS for apple trees thinning based on precision agriculture principles.  
Budget: 80,000\$/ year; 3 year, with V. Elhanati as P.I. Researcher's part: 15,000\$/ year.
- 2018 - MIGAL  
Title: Development strategy to decrease alternate bearing in apple using GA biosynthesis inhibitor during flower induction.  
Budget: 30,000\$/ year; 1 year, P.I. Researcher's part: 30,000\$/ year.
- 2018- MIGAL – Tel Hai.

Title: Development of functional and healthy superfood based on apple loss.  
 Budget: 15,000\$/ year; 1 year, with O. Benjamin as P.I. Researcher's part:  
 5,000\$/ year.

2019 - Chief Scientist of the Ministry of Agriculture (+ Fruit Board)

Title: Increasing litchi productivity by indentifying the optimal pollenizer for each cultivar.

Budget: 30,000\$/ year; 3 year, P.I. Researcher's part: 30,000\$/ year.

2019 - MIGAL

Title: Development strategy to decrease alternate bearing in apple using GA biosynthesis inhibitor during flower induction.

Budget: 10,000\$/ year; 1 year, P.I. Researcher's part: 10,000\$/ year.

2019 – MIGAL (JCA Accelerator)

Title: Developing a new healthy crop by crossing Graviola (*Annona muricata*) with Sugar-Apple.

Budget: 30,000\$/ year; 1 year, with U. Leshem as P.I. Researcher's part:  
 10,000\$/ year.

2020 - Chief Scientist of the Ministry of Agriculture

Title: Use of geothermal water for early ripening and harvesting in various fruit trees.

Budget: 40,000\$/ year; 3 year, P.I. Researcher's part: 40,000\$/ year.

2020 - Chief Scientist of the Ministry of Agriculture

Title: Improving yield of Hass and Gem avocado by increasing the duration of the female stage receptiveness due to 1-MCP (Harvista) treatment and pollination enhancement.

Budget: 35,000\$/ year; 3 year, with M. Goldway as P.I. Researcher's part:  
 5,000\$/ year.

2020 - Chief Scientist of the Ministry of Agriculture

Title: Evaluation of growing compact pear trees to improve yield.

Budget: 60,000\$/ year; 3 year, P.I. Researcher's part: 60,000\$/ year.

2020 - Chief Scientist of the Ministry of Agriculture

Title: Evaluation of new dwarfing apple and pear rootstocks.

Budget: 45,000\$/ year; 3 year, P.I. Researcher's part: 45,000\$/ year.

2020 - Chief Scientist of the Ministry of Agriculture

Title: Growing and marketing avocado all over the year.

Budget: 60,000\$/ year; 3 year, P.I. Researcher's part: 20,000\$/ year.



- 2020- Horticultural Board (Ministry of Agriculture).  
 Title: Improve yield of Hass avocado by Bumble bees.  
 Budget: 30,000\$/ year; 1 year, P.I. Researcher's part: 30,000\$/ year.
- 2020- Horticultural Board (Ministry of Agriculture).  
 Title: Increasing litchi productivity by indentifying the optimal pollenizer for each cultivar.  
 Budget: 10,000\$/ year; 1 year, P.I. Researcher's part: 10,000\$/ year.
- 2021 - Chief Scientist of the Ministry of Agriculture  
 Title: Fruit quality and storability of new pear cultivars in different growing areas.  
 Budget: 40,000\$/ year; 3 year, with M. Flaishman as P.I. Researcher's part: 20,000\$/ year.
- 2021- Horticultural Board (Ministry of Agriculture).  
 Title: Improve yield of Hass avocado by Bumble bees.  
 Budget: 35,000\$/ year; 1 year, P.I. Researcher's part: 35,000\$/ year.
- 2021- Horticultural Board (Ministry of Agriculture).  
 Title: Increasing litchi productivity by indentifying the optimal pollenizer for each cultivar.  
 Budget: 15,000\$/ year; 1 year, P.I. Researcher's part: 15,000\$/ year.
- 2022 - Chief Scientist of the Ministry of Agriculture  
 Title: Application of nets in combination with growth regulators in 'Cripps Pink' apples to prevent calyx-end cracking caused by extreme heatwaves.  
 Budget: 80,000\$/ year; 3 year, with I. Ginzberg as P.I. Researcher's part: 20,000\$/ year.
- 2022 – Horticultural Board (Ministry of Agriculture).  
 Title: Improve yield of Hass avocado by Bumble bees.  
 Budget: 30,000\$/ year; 1 year, P.I. Researcher's part: 30,000\$/ year.
- 2022 – Shoham packing House  
 Title: Crop improvement in infertile mango varieties by bumble bees.  
 Budget: 20,000\$/ year; 1 year, P.I. Researcher's part: 20,000\$/ year.
- 2023 – Chief Scientist of the Ministry of Agriculture + Ministry of Energy  
 Title: Using photo voltaic panels for agriculture – litchi and kiwi (Agrovoltai).  
 Budget: 60,000\$/ year; 5 year, Researcher's part: 60,000\$/ year.
- 2023 – Shoham packing House  
 Title: Improve pollination by bumble bees increases mango yield

Budget: 30,000\$/ year; 1 year, Researcher's part: 30,000\$/ year.

2023 – Horticultural Board (Ministry of Agriculture).

Title: Improve pollination by bumble bees increases mango yield.

Budget: 20,000\$/ year; 1 year, P.I. Researcher's part: 20,000\$/ year.

2023 – Chief Scientist of the Ministry of Agriculture

Title: Development of technologies to improve lychee yield in extreme heat and cold growing conditions

Budget: 70,000\$/ year; 3 year, Researcher's part: 70,000\$/ year.

2023 – Chief Scientist of the Ministry of Agriculture

Title: Increasing litchi profitability in Israel by introduction and breeding of cultivars with high fruit quality, high yield and adaptation to the local climate and climate change

Budget: 80,000\$/ year; 10 year, with S. Harpaz as P.I. Researcher's part: 20,000\$/ year.

2024 – Chief Scientist of the Ministry of Agriculture

Title: Increasing yield and fruit quality in litchi by reducing heat stress at summer and preventing frost at winter using nets and sprinklers.

Budget: 35,000\$/ year; 3 year, P.I. Researcher's part: 35,000\$/ year.

2024 – Horticultural Board (Ministry of Agriculture).

Title: Litchi breeding.

Budget: 10,000\$/ year; 1 year, P.I. Researcher's part: 10,000\$/ year.

2024 – Horticultural Board (Ministry of Agriculture).

Title: Litchi fertility.

Budget: 10,000\$/ year; 1 year, P.I. Researcher's part: 10,000\$/ year.

2024 – Horticultural Board (Ministry of Agriculture).

Title: Improve pollination by bumble bees increases mango yield.

Budget: 20,000\$/ year; 1 year, P.I. Researcher's part: 20,000\$/ year.

## LIST OF PUBLICATIONS

### ARTICLES IN REVIEWED JOURNALS (*h index = 30*)

1. Gur, A., Altman, A., **Stern, R.A.** and Wolowitz, B. 1986. Improving rooting and survival of softwood peach cuttings. *Scientia Hort.* 30: 97-108.
2. Gur, A., Altman, A., **Stern, R.A.**, Sigler, T. and Wolowitz, B. 1987. Interaction between myo-inositol and cytokinins: their basipetal transport and effect on peach roots. *Physiol. Plants* 69: 633-638.
3. **Stern, R.A.**, Adato, I., Goren, M., Eisenstein, D. and Gazit, S. 1993. Effect of autumnal water stress on litchi flowering and yield in Israel. *Scientia. Hort.* 54: 295-302.
4. **Stern, R.A.**, Gazit, S., El Batsri, R. and Degani, C. 1993. Pollen parent effect on outcrossing rate, yield and fruit characteristics of “Floridian” and “Mauritius” lychee. *J. Am. Soc. Hort. Sci.* 118: 109-114.
5. **Stern, R.A.**, Kigel, J., Tomer, E. and Gazit, S. 1995. Mauritius lychee fruit development and reduced abscission after treatment with auxin 2,4,5,-TP. *J. Am. Soc. Hort. Sci.* 120: 65-70.
6. Degani, C., **Stern, R.A.**, El Batsri, R. and Gazit, S. 1995. Pollen parent effect on the selective abscission of Mauritius and Floridian lychee fruits. *J. Am. Soc. Hort. Sci.* 120: 523-526.
7. **Stern, R.A.** and Gazit, S. 1996. Lychee pollination by the honeybee. *J. Am. Soc. Hort. Sci.* 121:152-157.
8. **Stern, R.A.**, Eisenstein, D., Voet, H. and Gazit, S. 1996. Anatomical structure of two day old litchi ovules in relation to fruit set and yield. *J. Hort. Sci.* 71: 661-671.
9. **Stern, R.A.**, Eisenstein, D., Voet, H. and Gazit, S. 1997. Female Mauritius litchi flowers are not fully mature at anthesis. *J. Hort. Sci.* 72: 19-25.
10. **Stern, R.A.**, Nadler, M. and Gazit, S. 1997. Floridian litchi yield is increased by 2,4,5-TP spray. *J. Hort. Sci.* 72: 609-615.
11. **Stern, R.A.** and Gazit, S. 1997. Effect of 3,5,6-trichloro-2-pyridil-oxyacetic acid on fruit set, abscission and yield of Mauritius litchi. *J. Hort. Sci.* 72: 659-663.

12. **Stern, R.A.** and Gazit, S. 1998. Pollen viability in lychee. *J. Amer. Soc. Hort. Sci.* 123: 41-46.
13. **Stern, R.A.**, Meron, M., Naor, A., Wallach, R., Bravdo, B. and Gazit, S. 1998. Effect of fall irrigation level in Mauritius and Floridian lychee on soil and plant water status, flowering intensity and yield. *J. Amer. Soc. Hort. Sci.* 123: 150-155.
14. **Stern, R.A.** and Gazit, S. 1999. The synthetic auxin 3, 5, 6 - TPA reduces fruit drop and increases yield in 'Kaimana' litchi. *J. Hort. Sci. and Biotech.* 74: 203-205.
15. Goldway, M., Shai, O., Yehuda, H., Matityahu, A. and **Stern, R.A.** 1999. 'Jonathan' apple is a lower-potency pollenizer of 'Topred' than 'Golden Delicious' due to partial S-allele incompatibility. *J. Hort. Sci. and Biotech.* 74: 381-385.
16. **Stern, R.A.**, Stern, D., Harpaz, M. and Gazit, S. 2000. Applications of 2,4,5-TP, 3,5,6-TPA and combinations thereof increases lychee fruit size and yield. *HortScience*, 35: 661-664.
17. **Stern, R.A.** and Gazit, S. 2000. Application of the polyamine putrescine increased yield of 'Mauritius' litchi (*litchi chinensis* Sonn.) *J. Hort. Sci. and Biotech.* 75: 612-614.
18. Naor, A., Peres, M., Greenblat, Y., Doron, I., Gal, Y. and **Stern, R.A.** 2000. Irrigation and crop load interactions in relation to pear yield and fruit size distribution. *J. Hort. Sci. Biotech.* 75: 555-561.
19. Flaishman, M., Shargal, A. and **Stern, R.A.** 2001. The synthetic cytokinin CPPU increased fruit size and yield of 'Spadona' and 'Coscia' pears (*Pyrus communis* L.). *J. Hort. Sci. Biotech.* 76: 145-149.
20. **Stern, R.A.**, Dag, A. and Eisikowitch, D. 2001. Sequential introduction of honeybee colonies and doubling their density increases cross-pollination, fruit set and yield in 'Red Delicious' apple. *J. Hort. Sci. Biotech.* 76: 17-23.
21. Schneider, D., **Stern, R.A.**, Eisikowitch, D. and Goldway, M. 2001. Analysis of S-allele by PCR for determination of compatibility in the Red Delicious apple orchard. *J. Hort. Sci. and Biotech.* 76: 596-600.
22. Schneider, D., **Stern, R.A.**, Eisikowitch, D. and Goldway, M. 2001. Determination of the self fertilization potency of Golden Delicious apple. *J. Hort. Sci. and Biotech.* 76: 259-263.

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26. **Stern R. A.**, Ben-Arie, R., Neria, O. and Flaishman, M. A. 2003. CPPU and BA increases fruit size of 'Royal Gala' (*Malus domestica*) apple in a warm climate. *J. Hort. Sci. and Biotech.* 78: 297-302.
27. **Stern, R.A.**, Naor, A., Bar, N. Gazit, S. and Bravdo, B. 2003. Xylem-sap Zeatin-Riboside and Dihydrozeatin-riboside levels in relation to plant and soil water status and flowering in 'Mauritius' litchi. *Scientia Hort.* 98: 285-291.
28. Naor, A., Flaishman, M., **Stern, R.A.**, Moshe, A. and Erez, A. 2003. Temperature effects on dormancy completion of vegetative buds in apple. *J. Amer. Soc. Hort. Sci.* 128: 636-641.
29. Sapir, G., **Stern, R.A.**, Eisikowitch, D. and Goldway, M. 2004. Cloning of four new Japanese plum S-alleles and determination of the compatibility between cultivars by PCR analysis. *J. Hort. Sci. and Biotech.* 79: 223-227.
30. Zisovich, A.H., **Stern, R.A.**, Shafir, S. and Goldway, M. 2004. Identification of seven S-alleles from the European pear (*Pyrus communis*) and determination of compatibility among cultivars. *J. Hort. Sci. and Biotech.* 79: 101-106.
31. Zisovich, A.H., **Stern, R.A.**, Sapir, G., Shafir, S. and Goldway, M. 2004. The RHV region of S-RNase in the European pear (*Pyrus communis*) is

- not required for the determination of specific pollen rejection. *Sexual Plant Reproduction* 17: 151-156.
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  35. Zisovich, A.H., **Stern, R.A.**, Shafir, S. and Goldway, M. 2005. Fertilisation efficiency of semi- and fully- compatible European pear (*Pyrus communis*) cultivars. *J. Hort. Sci. and Biotech.* 80: 143-146.
  36. Schneider, D., **Stern, R.A.**, and Goldway, M. 2005. A comparison between semi- and fully compatible apple pollinators grown under suboptimal conditions. *HortScience* 40: 1280-1282.
  37. Naor, A., **Stern, R.A.**, Peres, M., Greenblat, Y., Gal, Y. and Flaishman, M., 2005. Timing and Severity of post-harvest water-stress affects following year productivity and fruit quality of field-grown ‘Snow-Queen’ nectarine. *J. Amer. Soc. Hort. Sci.* 130: 806-812.
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  40. **Stern, R.A.**, Nerya, O. and Ben Arie, R. 2006. The cytokinin CPPU delays maturity in litchi cv. ‘Mauritius’ and extends storage-life. *J. Hort. Sci. and Biotech.* 81: 158-162.
  41. Naor, A., **Stern, R.A.**, Flaishman, M., Gal, Y. and Peres, M. 2006. Effects of post harvest water stress on autumnal bloom and subsequent-season productivity in mid-season Spadona pear. *J. Hort. Sci. and Biotech.* 81: 365-370.

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43. **Stern, R.A.** and Ben-Arie, R. 2006. Preharvest drop control of 'Red Delicious' and 'Jonathan' apple (*Malus domestica*) as affected by the synthetic auxin 3,5,6-TPA. J. Hort. Sci. and Biotech. 81: 943-948.
44. **Stern, R.A.**, Flaishman, M. and Ben-Arie, R. 2007. Effect of synthetic auxins on fruit size of five cultivars of Japanese plum (*Prunus salicina* L.). Scientia Hort. 112: 304-309.
45. **Stern, R.A.**, Flaishman, M. and Ben-Arie, R. 2007. The effect of synthetic auxins on fruit development, quality and final fruit size of 'Canino' apricot (*Prunus armeniaca* L.). J. Hort. Sci. and Biotech. 82: 335-340.
46. **Stern, R.A.**, Sapir, G., Shafir, S., Dag, A. and Goldway, M. 2007. The appropriate management of honey bee colonies for pollination of Rosaceae fruit trees in warm climates – Invited review. Middle Eastern and Russian Journal of Plant Science and Biotech. 1: 13-19.
47. Sapir, G., Goldway, M., Shafir, S. and **Stern, R.A.** 2007. Multiple introduction of honeybee colonies increases cross-pollination, fruit-set and yield of 'Black-Diamond' Japanese plum (*Prunus salicina* Lindl.). J. Hort. Sci. and Biotech. 82: 590-596.
48. **Stern, R.A.**, Flaishman, M., Applebaum, S. and Ben-Arie, R. 2007. Effect of synthetic auxins on fruit development of 'Bing' cherry (*Prunus avium* L.). Scientia Hort. 114: 275-280.
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50. **Stern, R.A.**, Doron, I. and Ben Arie, R. 2007. Plant growth regulators increase the fruit size of 'Spadona' and 'Coscia' pears (*Pyrus communis*) in a warm climate. J. Hort. Sci. and Biotech. 82: 803-807.
51. Sapir, G., **Stern R.A.**, Shafir, S. and Goldway, M. 2007. SFBs of Japanese plum (*Prunus salicina*): Cloning seven alleles and determining their linkage to the S-RNase gene. HortScience, 42: 1509-1512.

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62. **Stern R.A.**, Korchinsky, R., Ben-Arie, R. and Cohen, Y. 2010. Early application of the synthetic auxin 2,4-DP enhances the red colouration of 'Cripp's Pink' apple. *J. Hort. Sci. and Biotech.* 85: 35-41.



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### **PATENT**

1. Patent application No. 60/953,098 (July 31, 2007) at the U.S. Patent and Trademark Office (USPTO): "**Use of uniconazole as a fruit thinning agent**".  
Inventors: Raphael Stern and Martin Goldway.
2. Patent application No. 61/056,202 (June 19, 2008) at the U.S. Patent and Trademark Office (USPTO): "**Method for improving colour in pome and stone fruits**".  
Inventor: Raphael Stern.
3. US Provisional Patent Application No. 63/603,148 (November 28, 2023): "**system and method for controlling ripening time of fruit**".  
Inventor: Raphael Stern.

## LIST OF MAJOR ACHIEVEMENTS

### **CONTRIBUTION TO AGRICULTURAL RESEARCH**

My research experience includes field and laboratory studies, with special emphasis on the mechanism of fruit tree productivity. My research has concentrated on the following aspects of pollination, fertilization and fruit development of subtropical and deciduous trees.

#### **A. Improving Lychee Productivity**

Worldwide, lychee suffers from the problem of low and irregular bearing. At the end of the 1980s I began a comprehensive study of the reproductive biology of lychee in Israel, with special emphasis on the factors responsible for its poor productivity. The improved understanding obtained enabled us to devise new treatments to improve productivity. Some of these treatments, described below, have also been successfully applied in the main countries growing litchi: China, Florida, Spain and South Africa.

##### **1. Autumnal water stress to improve flowering**

In Israel, under a hot and dry summer and cool and rainy winter, lychee trees flower poorly and therefore bear erratic yields. In my research I found that water management after harvest could influence flowering intensity. Autumnal water stress, from early October to the start of the rainy season inhibited vegetative growth and increased the cytokinin levels in the buds, resulting in profuse flowering and a dramatic increase in yield. Due to optimization of the water stress regime, along with a reliable indicator for irrigation control (xylem water potential), the yield was doubled. This autumnal water stress regime has been adopted by the lychee industry in Israel and is now considered a routine method. In addition this method has the added advantage of saving about 15% of irrigation water.

##### **2. Auxin treatments to reduce fruitlet abscission**

In lychee, even after profuse flowering, induced by autumnal water stress, the yield is often inadequate, mainly as a result of massive fruit drop during the early period of fruit development. In my research, I found that the main abscission wave occurs at the stage of rapid growth of the embryo, which coincides with a fall in the level of endogenous auxin. Two synthetic auxins (2,4,5-TP and 3,5,6-TPA), which were sprayed on the fruitlet at this time, were found to consistently and significantly reduce

lychee fruitlet abscission and dramatically increase the yield of the two main cultivars in Israel and another cultivar in China. Both auxins are now routinely applied in commercial lychee orchards in Israel.

### 3. Auxin treatment to increase fruit size

Size is an important element in marketing fresh lychee fruit, and some of the commercial cultivars do not achieve sufficient size. I have found that treatment with 3,5,6-TPA, applied about a week after the 2,4,5-TP treatment to reduce abscission, increased fruit weight of all 3 commercial cultivars grown in Israel, as well as that of 3 other important cultivars in China. This increase cannot be explained as a result of fruit thinning (as in citrus, apple, etc.), but due to the fruit becoming a stronger sink.

In view of my research activity on lychee I was asked to write a chapter on “Plant Growth Regulators in Lychee” in the book “Plant Growth Regulators in Agriculture and Horticulture”, which was published in 2000, a chapter on “The Reproductive Biology of the Lychee” for “Horticulture Reviews”, published in 2003, and 4 chapters on “Lychee and Longan” (“Flowering”, “Fruit set and Development”, “Taxonomy, Botany and Plant Development” and “Origin, History, Production and Processing”) for the book “Lychee and Longan: botany, cultivation and uses”, which was published by CABI Publishing in 2005. On 2014, I was the keynote speaker on litchi productivity at the Tropical Symp., which held during the 29<sup>th</sup> International Horticultural Congress in Brisbane, Australia.

## **B. Increasing Fruit Size**

In the warm climate of Israel a lot of fruit species produce a relatively small fruits, which obtains low prices on the market. Therefore, the economic benefits of treatments capable of improving the average fruit size are potentially very high.

### 1. Apple and pear

I have found that in three pear cultivars (Spadona, Coscia and Spadochina) and three apple cultivars (Red-Delicious, Golden-Delicious and Royal-Gala) the endogenous cytokinin level does not permit the full exploitation of the cell division phase of fruit growth. When treated with the synthetic cytokinin (CPPU, BA or TDZ) at the cell division phase, fruit size was increased and fruit size distribution changed dramatically without affecting fruit thinning and fruit shape. As a result, an increase in

yield was obtained. In pears, I found many more cells at the cell division phase and a longer cell division period in treated fruit compared to control fruit.

This method is now routinely applied in commercial apple and pear orchards in Israel.

## 2. Plum, apricot and cherry

I have found that the endogenous auxin level does not permit to the full exploitation of the cell expanding phase of fruit growth. When treated with the synthetic auxin (2,4-DP; 3,5,6-TPA; NAA+2,4-D) at the pit hardening phase, fruit size was increased without affecting fruit thinning and shape.

### **C. Pollination in Deciduous (apple, pear and plum) and Subtropical (avocado and lychee) Fruit**

The 'Red Delicious' apple, the 'Spadona' pear and most of the plum cultivars exhibit complete self-incompatibility, therefore their fruit production depends totally on cross pollination, especially by honeybees, which are the ultimate apple and pear pollinators. Weather conditions during the blooming period may be unfavorable for bee flight, pollination, pollen-tube growth and fertilization making the extent of cross pollination the yield-limiting factor. I have developed a new technique of sequential introduction of honeybee colonies and, by doubling their density, have significantly improved bee activity and efficiency in cross pollination, leading to considerable increase in yield and fruit size (total number of fruit per tree, and larger fruit due to increased seed number). This technique is now applied in all commercial apple, pear and plum orchards in Israel. In a new research I have found that adding bumble bees to the apple and pear orchards increased the activity of honey bees on the flowers and improved their efficiency as pollinators. As a result we received more seeds which increased the size of the fruit. In my latest research (2015-2019) I have found that in avocado, that is not attractive at all and even in lychee trees, which are very attractive to honey bees, I managed to increase the percentage of cross-pollination by adding bumble bees to the honey bee hived in the orchard. As a result we received better yield and fruit size.



### **D. The Gametophytic Self-Incompatibility Fertilization System in Apple, Pear, Plum and Apricot**

In apples, pears and other fruit belonging to the Rosaceae plant family, fertilization is controlled by the gametophytic self-incompatibility (GSI) fertilization system. As a result, in order to achieve fruit-set and yield, cultivars depend on cross-pollination by a compatible pollenizer. In GSI, the outcome of pollination is determined by a single polymorphic gene locus, the S-locus. When the pollen grain carries an S-allele, which is harbored also in the pistil, it will be rejected. Yet, when the pollen S-allele differs from that of the pistil, fertilization will take place.

Since the GSI system has not been fully elucidated, I have studied it in order to increase our understanding of how this system works and to identify the best pollenizers for ‘Red Delicious’ apple, ‘Spadona’ pear and some Japanese plum cultivars.

The S alleles of all the apple, pear, apricot and Japanese plum cultivars, grown in Israel, have been identified. Thus, a full picture of the pollen flow in the orchard could be achieved. For example, in apple I found that ‘Jonathan’ is a weak pollenizer for ‘Red Delicious’ compared to ‘Golden Delicious’ due to semi-compatibility between ‘Jonathan’ and ‘Red Delicious’; that ‘Golden Delicious’ features a very poor self-compatibility in the warm climate of Israel and so on.

The method in all species is being applied in order to investigate cases in which pollination and fertilization are suspected to be the main reason for low yields, over-cropping or low fruit quality.

### **E. Thinning of Stone Fruit: Peach-Nectarine, Cherry, Apricot and Plum)**

Commercial success on stone fruit cultivation, especially peach, nectarine and apricot, depends on fruit thinning, in order to reduce crop load and to obtain large-sized fruit that gains good prices. However, no successful chemical thinning method has so far been developed for stone fruit, as for pome fruit. Therefore, hand thinning is practiced, although this is less effective in enlarging the fruit, as well as being more expensive. I have developed three different chemical methods to replace hand thinning, which are being adopted in commercial stone fruit orchards:

1. Gibberellin sprays at the time of fruit bud differentiation (summer), that reduce flower production in the following year, half the time required for hand thinning (for correction) and greatly improve fruit size distribution.

2. Cyanamide application in the winter to kill the fruit buds, with results similar to those achieved with gibberellin sprays.
3. Diluet treatment in the spring to burn the flowers, reduces the total crop and improves fruit size.
4. Uniconazol – I have recently been studying a series of different compounds aimed at interfering with fertilization by inhibiting pollen grain germination. Results so far are very impressive and there is good promise for commercial application in the near future in all stone fruit orchards.

#### **F. Reducing Calyx Cracking in 'Pink Lady' Apple by PGR's**

Russetting and cracking of fruit skin are major disorders that limit fruit quality and marketability. The causes suggested to be environmental condition, orchard management and failure of the skin to resist surface tensions due to fruit expansion. Basically, fruit skin is made of epidermis cells and cuticular matrix.

Increased cuticle thickness, higher epidermal cell density and cell morphology that support strong adhesion between neighboring cells are characteristic of fruits tolerant to cracking compared to susceptible genotypes. Apple is being increasingly considered as a model for fruit development studies. I have shown that spraying a mixture of gibberellin A4 plus A7 (GA4+7) and the cytokinin 6-benzyl adenine (BA) at cell division stage of 'Pink Lady' apple fruit development resulted reduced incidence of skin cracking by maintaining a higher number of epidermal cells compared to untreated fruit.

I hypothesize a common mechanism for BA + GA4+7 effect on fruit skin, and propose to view the skin as a tissue whose characteristics may be manipulated to improve its resistance to environmental and growth strains.

The technique I developed is now applied in all commercial 'Pink Lady' apple orchards in Israel and one bonus is the dramatic reduction of the alternaria disorder.