

# Processing Carrot Research Program



## MISSION

"To establish, coordinate, liaise, research, develop, demonstrate, and constantly upgrade processing carrot production techniques and technologies for enhancing yield and quality, sustaining productivity and profitability to the producers, processors, using environmentally friendly, resource thrifty technologies, and to be the world leader in processing carrot research and development".

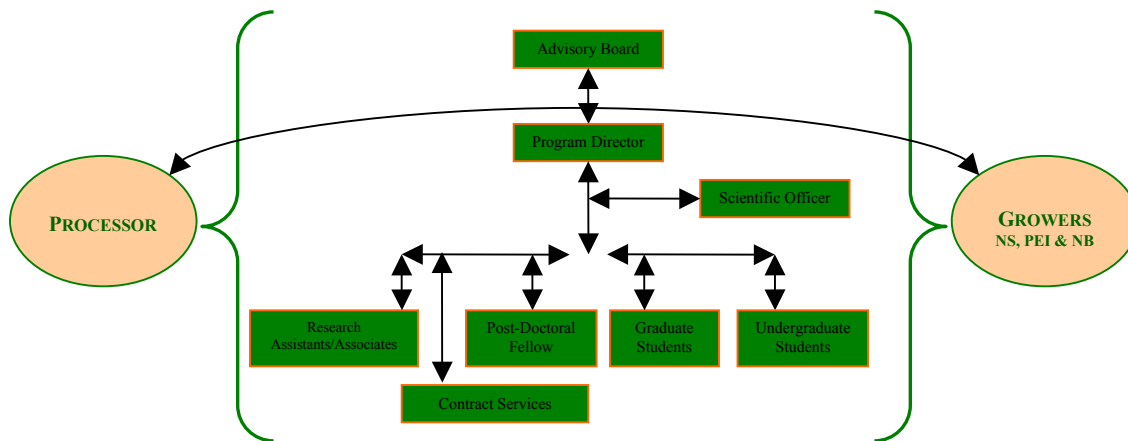
## INDUSTRY

- Nova Scotia is the largest producer of carrots for freeze processing in Canada.
- Oxford Frozen Foods is the largest processor of frozen carrots in Canada and one of the largest in North America.
- In 2003, approximately 2800 acres of sliced, diced and cut and peel carrots were grown for processing throughout the three maritime provinces, 80% of which were grown in Nova Scotia.

## HISTORY OF PCRP

- Established in 1998.
- Co-sponsored by Oxford Frozen Foods Ltd, NS Dept. of Agriculture and Fisheries and Nova Scotia Agricultural College.
- Advisory Board comprised of representatives from the carrot industry, growers (NS and PEI), NSAC Administration, NSDAF, and both NSAC and AAFC researchers.

## STRUCTURE

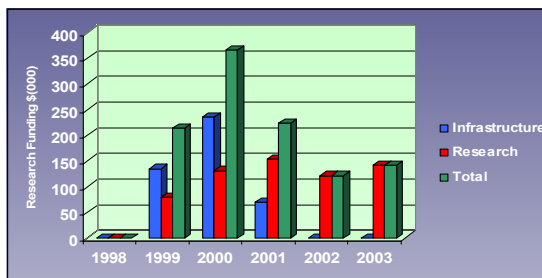


## PERSONNEL

- Dr. Rajasekaran Lada – Program Director
- Azure Stiles – Scientific Officer
- Christine Pettipas – Research Assistant/Graduate Student
- James Burke – Research Assistant
- Phillip Joy – Research Assistant
- Ravishankar Palanisamy – Graduate Student
- Rowan Briscoe – Graduate Student
- Veronique Comeau – Summer Research Assistant
- Geoff Shinkle – Undergraduate Student

## RESEARCH THEMES

- Varietal Introduction and Adaptation
- Crop Competition and Yield and Quality Modeling
- Resource Optimization and Modeling
- Stand Establishment and Seedling Physiology
- Physiological Disorders
- Stress Physiology and acclimation
- Bulking Physiology
- Eco Physiology
- Pest and Disease Forecasting – CIPRA Calibration
- EEES Carrot Based Cropping Systems



## RESEARCH FUNDING

- NSERC – CRD
- Oxford Frozen Foods
- NSDAF
- CFI (Infrastructure)
- Technology Development
- AWARD 2000
- AIF

## COLLABORATORS

- **NSAC:** Drs. C. Caldwell, A. Madani, R. Gordon, P. Havard, T. Astakie, D. Percival, Profs. C. Miller, G. Sampson
- **NSDAF (1998 – 2001):** D. Sangster, P. Swinkels, R. Whitman, L. Crozier
- **AgraPoint:** F. MacRae, P. Burgess, V. Zvalo
- **AAFC:** P. Hicklenton, AAFC, Kentville; K. Sanderson, AAFC, Charlottetown; Dr. G. Bourgeois, Horticultural Research and Development Centre, Saint-Jean, Quebec; J. Owen, AAFC, Bouctouche

- **PEI Dept. of Agriculture:** Dr. T. Sturtz
- **Seed Companies:** Bejo, Seminis, Harris Moran, Stokes, Vesey's
- **Fertilizer Companies:** Truro Agro Mart, NS; Phosyn, UK
- **Growers and Grower organizations:** Bragg Lumber Company, T. Meredith, T. Bowers, D. Congdon, T. Meredith Sr.; PEI Horticultural Association; Hort Nova
- **Universities – National:** Dr. T.J. Blake, University of Toronto; Dr. D. Hooper, Dalhousie University; Dr. F. Shahidi, Memorial University; Dr. Robert Drobovitch, Dalhousie University
- **Universities/organizations-International:** Dr. P.Simon, University of Wisconsin, Madison; Dr. I.Goldman, University of Wisconsin, Madison University of Iowa, USDA-ARS; Dr. Usha Palaniswamy, University of Connecticut, USA; Asian Vegetable Research and Development Centre, Taiwan; Dr. B.P.Naidu, University of Queensland, Brisbane, Qld, Australia

#### TRAINING OF HQP

- 1 Scientific Officer
- 8 Research Assistants
- 7 Summer Research Assistants (students)
- 6 Graduate Students
- 1 Post-doctoral Fellow
- 6 Undergraduate Honours Students
- 7 Scientists/Researchers (AVRDC)

#### OUTREACH

- 'Participatory Research'
- 'Lab to Land Program'
- 'Beta' and 'Dacus' – Quarterly newsletters
- Field tours and exhibits to industry and public groups
- Highlight research through the PCRP website, grower meetings and field days, TV interviews, and vegetable production magazines

#### SALIENT RESEARCH FINDINGS

- Multi-year yield averages indicate the slicer variety Tempo as a top performer which consistently out yields the standard varieties. In the dicer category, Cascade is a high quality, consistent variety.
- It has been found that there is no interaction between Phosphorus and Potassium for carrots. Application of P and K fertilizers at any level did not enhance yield or quality.
- In a soil sulphur survey, King's County fields were found to be significantly lower in sulphur compared to Colchester County fields.
- Optimal soil moisture for carrot production was found to be near -40 Cbars. Maintaining soil moisture above -60 Cbar enhanced yield by nearly 2 fold. Critical timings for irrigation are early season for proper emergence and stand establishment and mid season during the early bulking stage.
- Critical soil temperature for optimal germination is 20 – 25 degrees C.
- Optimal soil moisture for emergence is 40% field capacity. Below 20% FC emergence is completely inhibited.
- Salicylates and GA<sub>3</sub> promoted germination at 5 degrees C.
- Ambiol and glycinebetaine were equally effective in enhancing germination at 25% FC
- Ethrel 10ppm + Spermine 0.1 ppm sprayed on carrot seedlings at 2 and 4 weeks after emergence significantly enhances yield.
- Hilling up soil over root crowns twice at 20-25 and 45-50 days after emergence significantly reduces the occurrence of green shoulders at harvest.
- It has been found that cumulative rainfall, cumulative, degree days, cumulative solar radiation and cumulative high temperature all significantly correlate with yield. One or all of these parameters could be used for modeling maturity and plan harvesting.
- 28 genera of endophytes have been identified in carrot root tissue. Seedlings inoculated with *Pseudomonas fluorescens* demonstrated a 74% increase in plant growth under drought conditions compared to an untreated control.
- Quaternary Ammonium Compounds have been discovered in carrot, onion and tomato seedlings under drought stress.

#### RECENT PUBLICATIONS

- Kyei-Boahen S., Rajasekaran L.R., Astatkie T., Gordon R., C. Caldwell 2003. Photosynthetic responses of carrots to varying irradiances. *Photosynthetica* 41 (2) XXX XXX, 2003
- Surette M.A., Sturtz A.V., Rajasekaran L.R., J. Nowak 2003. Bacterial endophytes in processing carrots (*Dacus carota* L. var. sativus): their localization, population density, biodiversity and their effects on plant growth *in vivo*. *Plant and Soil* 253: 1381-1390
- Islam M.A., Blake T.J., Kocacinar F., L.R. Rajasekaran 2003. Ambiol, spermine, and aminoethoxyvinylglycine prevent water stress and protect membranes in *Pinus strobes* L under drought. *Trees* 17: 278-284
- Rajasekaran L.R., Stiles A.D., C.D. Caldwell 2002. Stand establishment in processing carrots – Effects of various temperature regimes on germination and the role of salicylates in promoting germination at low temperatures. *Can J. of Plant Sci.* 82: 443-450
- Rajasekaran L.R. and T.J. Blake 2002. Seed pre-treatment using a derivative of 5-hydroxybenzimidazole (AMBIOL) pre-acclimates carrot seedlings to drought. *Can. J. of Plant Sci.* 82: 195-202
- Rajasekaran L.R., Aspinall D., Jones G.P., L.G. Paleg 2001. Stress metabolism. IX. Effect of salt stress on trigonelline accumulation in tomato. *Can. J. of Plant Sci.* 81: 487-498
- Rajasekaran L.R. and T.J. Blake 1999. New plant growth regulators protect photosynthesis and enhance growth under drought of Jack Pine seedlings. *J. Plant Growth Regul.* 18: 175-181

