

RESEARCH

FOCUS: SUSTAINABLE IMPROVEMENT OF PLANT AND FRUIT QUALITY

Initially my research endeavors focused on fruit quality (particularly fruit size) of apples via crop load, and investigated the impact of various environmental factors like winter chilling and spring temperatures on fruit size; this research was primarily funded through various Deciduous Fruit Industry programs.

Of late, my research focus was adapted to three key areas: 1) plant nutrition, 2) climate and 3), root growth dynamics (Fig 1).

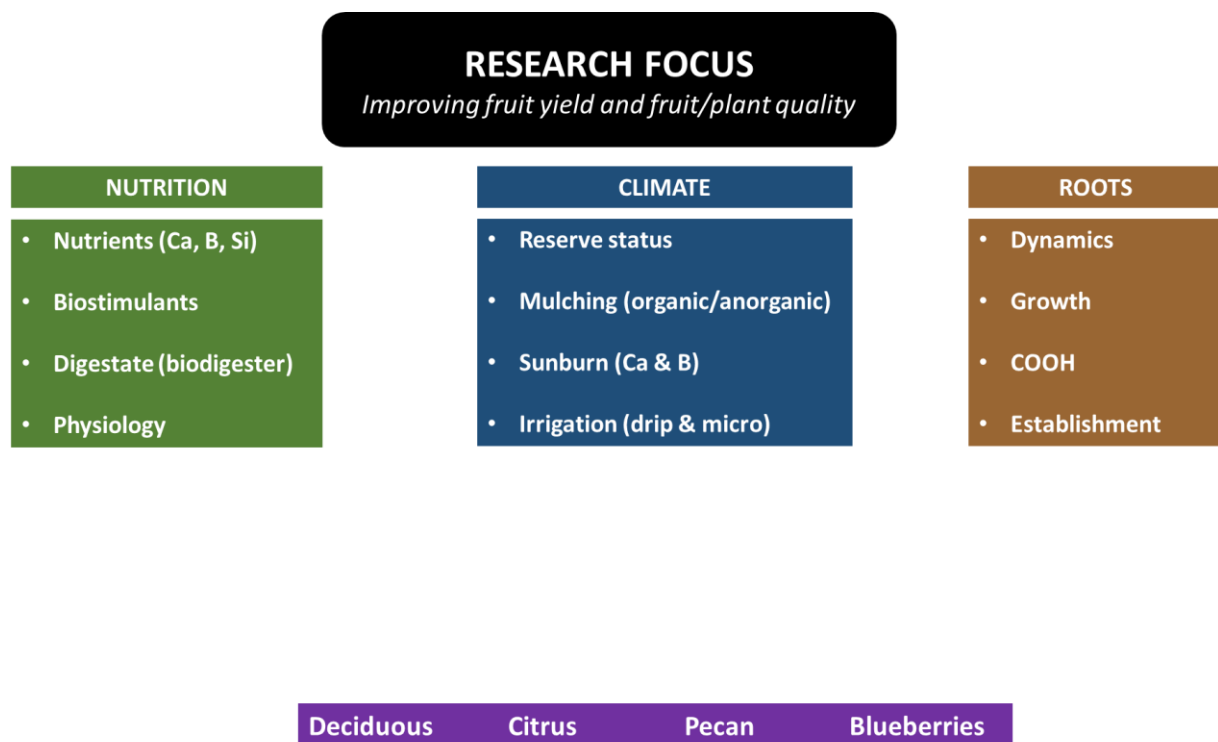


Fig 1 Research focus- facilitating a sustainable change

Plant Nutrition: I have now extended my field of expertise by investigating the role of nutrition on fruit quality, with special emphasis on the role of calcium (Ca) and boron (B). My research findings convinced local producers to adapt their Ca-application protocols, which lead to a significant increase in fruit quality (les bitter pit) and with substantial higher volumes of fruit that could be delivered to the export market. My research on foliar applications of a Ca and B combination showed a significant reduction of class 1 sunburn in apples, whereby income is increased in susceptible cultivars when this practice is followed.

International symposiums on Biostimulants in Agriculture provided sufficient evidence to include biostimulant-related projects into my teaching and research program, owing to the contributions of biostimulants to ensure sustainable, more environmental friendly agricultural practices.

Exposure to the DST-NRF Center of Excellence in Food Security enabled me to accept the new challenge of alternative nutrient resource management to enhance soil fertility via liquid and solid waste products from anaerobic bio-digestion (AB). AB also addresses sustainable practices and projects in this regard form an important area of training post graduate students in the Sustainable Agriculture program at the SU.

Climate: Research projects with this focus include evaluation of drip vs micro irrigation, the reduction of sunburn and evaluation of mulches and cover crops in commercial orchards.

Root growth dynamics: The role of roots in tree performance, water use and nutrient uptake is now another a major focus of research. By using a CID Root Scanner, we are able to quantify root growth dynamics non-destructively and in situ. This has resulted in various project pertaining the effect of soil applied treatments and so far involves studies on apple, citrus and maize crops. Collaboration with UP and the CSIR with regard to apple tree water use efficiency also involves root growth dynamics.

Summary of research outputs: The following outputs emanated from my research:

- 2005-2010: Five papers in peer-reviewed journals and 3 full length peer-reviewed papers in international conference proceedings
- 2011-2015: Nine papers in peer-reviewed journals and 5 full length peer-reviewed papers in international conference proceedings
- 2016 – current: Four papers in peer-reviewed journals and 2 full length peer-reviewed papers in an international conference proceedings

TEACHING

Teaching responsibilities and scope of teaching: Approximately 30 % of my time

is devoted to pre-graduate teaching activities. My teaching involvement includes: i) Lecturing the topic 'Applied Plant Physiology in Mineral Nutrition (AP 464) at 4th year level to horticulture and agronomy students; ii) presenting selected orchard- and laboratory based practical classes to 3rd year horticultural students; iii) lecturing a small component of, and managing the Soil Health module within the MSc in Sustainable Agriculture program; and iv) training of postgraduate students in Horticultural Science and Sustainable Agriculture.

Teaching philosophy: It is important for our students to be empowered to have a holistic understanding of horticultural principles and to have the confidence to engage with producers, agro-companies and researchers alike on horticultural-based problems. Even if the exact topic is not familiar to them, they should have the ability to postulate and propose scientifically based solutions. I purposefully design challenging assignments and learning opportunities, based on the integration and application of knowledge, to prepare students to be able to deal with such situations effectively.

POSTGRADUATE SUPERVISION

My involvement in supervision and co-supervision of postgraduate students increased over time and provide evidence of my standing as a supervisor/promotor:

- 2005-2010: 2 MSc Agric students;
- 2011-2015: 7 MSc Agric students and 1 Postdoctoral fellow;
- 2016 – Current: 20 MSc Agric students and 4 PhD students.

My students for part of a study group where we also address the development of student attributes with reference to time management, presentation skills, planning and organising skills.

POSTGRADUATE RESEARCH STUDENTS

Completed MSc Agric theses:

1. J Joubert: MSc Agric thesis (co-supervisor) -The effect of different water and nutrient management strategies on the Ca content of apple fruit. Supervisor: Dr P.J.C. Stassen 2007
2. C.J. Kapp: MSc Agric thesis (co-supervisor) - Manipulation of the chilling requirement of sweet cherry trees. Supervisor: Dr N.C. Cook 2008
3. B. Makedredza: MSc Agric thesis (co-supervisor) -Mulching decreases while moisture stress increases sunburn development in apples. Supervisor: Dr W.J. Steyn 2012
4. P. Carmichael: MSc Agric thesis (supervisor) - Predicting optimum harvest time and eating quality of Forelle pears. 2010
5. R.W. Wilsdorf: MSc Agric thesis (supervisor) - Seasonal changes in concentration and distribution of Ca²⁺ in apple fruit after soil and foliar calcium applications. 2011
6. W.P. Kotze: MSc Agric thesis (supervisor) - Effect of mulches on fruit quality of Cripps' Pink apples. 2012
7. J.P.D. van der Merwe: MSc Agric thesis (supervisor) - Quantifying the effect of inorganic and organic mulches of 2 soil types on nutrient uptake and fruit quality of 'Cripps' Pink' apples. 2012
8. A.F. Nicholson: MSc Agric thesis (supervisor) - An investigation into factors in the root environment that affect growth and development of roots and the influence of ground covers on these factors. 2012
9. D.T. Hendricks: MSc Agric thesis (supervisor) - Determining the effect of applied salicylic acid and silica on systemic acquired resistance on fruit growth and quality. 2012
10. L. Butler: MSc Agric thesis (co-supervisor) -'Cripps' Pink' browning as influenced by pre-harvest factors. Supervisor: Dr E.M. Crouch. 2015
11. F.J. van Zyl: MSc Agric thesis (supervisor) - Apple root growth dynamics and fertilizer uptake. 2016
12. S. Kafula: MSc Agric thesis (supervisor) - The effects of different waste management strategies utilising dairy manure, food and fruit waste on the biogas production as a sustainable source of renewable energy. 2016
13. I. Kritzinger: MSc Agric thesis (co-supervisor) - A study of broken stones in plums. Supervisor: Dr M.M. Jooste. 2016
14. S.H. Daiber: MSc Agric thesis (supervisor) - Quantifying changes in tree physiology after amelioration to reduce sunburn on apples. 2017

15. M. Frazenburg: MSc thesis (co-supervisor) - Determining the time of formation of primary xylem and the effect thereof on Ca distribution in the dormant reproductive apple bud. Supervisor: Prof L. Dreyer. 2017
16. Q. Doko: MSc Agric thesis (co-supervisor) Modelling canopy conductance and water use of high yielding apple orchards. Supervisor: Dr N.J. Taylor 2018
17. E. le Roux: MSc Agric thesis- Investigating the effect of Metalosate Ca on fruit quality of apples and citrus. 2018
18. L. Jansen van Vuuren: MSc Agric thesis - Quantifying the effect of Black Urea™ / Black DAP™ application as alternative nitrogen source on fruit tree physiology, yield and fruit quality of an apple. 2018
19. P. Jordaan: MSc Sustainable Agric thesis – Evaluating the potential of the biogas industry in South Africa. 2018
20. R. Andrews: MSc Sustainable Agric thesis – Investigating the use of biodigestate as alternative source of mineral nutrients in aquaponics. 2018

Current dissertations:

1. B. Makedredza: A study of photo-thermal and pitburn damage in Japanese plums.
Promoter: Prof W.J. Steyn
2. A. Mwije: A study of the dynamics of sunburn reduction in apple (*Malus domestica*) using foliar applications of a combination of boron and calcium
3. F.S. Zirebwa: Establishing quantitative relationships between water relations, yield and quality of high performing commercial apple orchards in the winter rainfall area of South Africa. Promoter: Prof S.J.E. Midgley
4. I. Kritzinger: Study of the peel permeability of Japanese plums to moisture during fruit development on the tree.

Current theses:

1. I. Zurayk: MSc Agric thesis (co-supervisor) - Fertilization management of crops under NaCl fertigation induced salinity stress. Supervisor: Dr E.W. Hoffman
2. V. van Niekerk: MSc Agric thesis (Sustainable Agriculture) (co-supervisor) – The effect of increased animal densities on chemical, physical and microbiological characteristics in soil in the MZimbabwe catchment, South Africa. Supervisor: Dr H. Hawkens

3. A. Cameron: MSc Agric thesis - Quantifying the uptake as well as the allocation/distribution of Ca to different plant organs after a Ca soil application during the second white root flush in young potted apple trees.
4. C. Shereni : MSc Agric thesis - Investigating an alternative approach to fruit and tree quality management
5. P. Micklem: MSc Agric thesis - Increasing the yield of Wichita pecan trees by manipulating tree size and/or shape
6. M. Webber: MSc Agric thesis - Evaluating plant performance and nutrient uptake in deciduous fruit after soil fumigation under replant conditions, using alternative fumigants and biostimulants
7. E. Jansen van Rensburg: MSc Agric thesis- Investigating tree performance of young, non-bearing Kanzi/m9 irrigated by micro jet or drip irrigation during establishment
8. S. Oosthuizen: MSc Agric thesis (co-supervisor) - Carbon partitioning in low chill peach cultivars: the impact on yield in summer rainfall areas of South Africa. Supervisor: Dr N.J. Taylor
13. C. Wilson: MSc Agric thesis (co-supervisor) - Determining the active root growth and carbohydrate production in roots from soils of from different climatic conditions, tree age and altitudes Supervisor: Dr N.J. Taylor
14. T. J. Snyman: MSc Agric thesis - Increasing fruit set in Pecans
16. R Dedekind: MSc Agric thesis – Increasing vegetative breaks in Pecans
17. J. Davenport: MSc Sustainable Agric thesis – Re-visit the role of mulching in perennial commercial orchards.

Post doctoral candidates:

Dr S.S. Turketti: Evaluation of fruit quality – specifically lenticel break-down in apples and calcium concentration in tomatoes and apple tissues.