PROFESSOR JOHAN BURGER

Biography

Johan Burger has a BSc(Agric) degree from Stellenbosch University and a PhD in Microbiology (Molecular Plant Virology) from the University of Cape Town, and has since 1991 been managing research as principle investigator at the Agricultural Research Council, the CSIR and Stellenbosch University. His current research is focussed on various aspects of grapevine virology, with the ultimate aim of introducing virus resistance in grapevine cultivars. Towards this goal, his team is investigating the virus complexes responsible for the numerous virus diseases in grapevine, the role of small RNAs in biotic stresses caused by different grapevine pathogens, and the development of virus-based resistance constructs for the ultimate expression in grapevine cultivars. He teaches Molecular Genetics at Stellenbosch University and supervises three post-doctoral fellows and about 12 postgraduate students. He receives research funding from a diverse group of donors and has several national and international collaborations. He is a past Chair of Department of Genetics at Stellenbosch University and also serves on the management committees of a number of local and international professional associations. He serves on the boards of two companies and is the commanding officer of 3 Field Engineer Regiment, a Reserve Force army regiment, based in Cape Town.

Research areas

Some of the most economically important diseases of grapevine are caused by virus pathogens. Economic losses of several millions of Rands can be directly attributed to diseases like grapevine leafroll disease, Shiraz disease and Rupestris stempitting disease. The inefficiency of conventional control strategies and the lack of natural resistance to these viruses necessitate the development of resistance technologies based on genetic engineering of grapevine.

Projects towards this goal include the design and construction of virus-based vectors for over-expression of foreign genes or for post-transcriptional gene silencing of endogenous genes in model plants and in grapevine.

More fundamental research projects in our group include metagenomic studies of virus disease complexes in grapevine and the molecular characterisation of the viruses and genetic variants observed in these studies. Of particular interest is Grapevine leafroll-associated virus 3 (GLRaV-3) - information gathered from a study of the subgenomic RNAs of this virus, as well as their associated promoter areas, should contribute to resolve the complex replication strategy of GLRaV-3. Identification and characterisation of such a subgenomic promoter(s) may be exploited for the directed expression of transgenes in grapevine cells.

Earlier studies on the emerging Shiraz disease of grapevine in South Africa have identified at least three sequence variants of Grapevine virus A (GVA) and have indicated that at least one of these variants is closely associated with the disease. We are constructing infectious clones of all three sequence variants in order to elucidate their respective roles in the aetiology of Shiraz disease. Moreover, the availability of an infectious clone of GVA will provide a much-needed tool for

functional genomic studies in grapevine, since it would provide a vector for transient expression of any transgene in grape tissues. In collaboration with research teams at UCT and the Case Western Reserve University in Cleveland, Ohio, we are developing GVA as a targeting and therapeutic virus-nanoparticle for potential treatment of cancer. In addition, infectious clones of the two RNAs and satellite RNA of Grapevine fanleaf virus is being constructed, which circumvents the restriction of being phloem-bound, as is the case with the current GVA clones.

In 2006, a phytoplasma disease was observed in local vineyards. From symptomatic plants, we identified Aster Yellows (AY) phytoplasma. Subsequently we have developed qPCR-based diagnostics for this pathogen, and are investigating the use of antimicrobial peptides to introduce resistance against AY phytoplasma.

A study of the abiotic and biotic stress responses in grapevine, induced by drought and virus and/or phytoplasma, respectively are investigated at the small RNA level. Our project compare differential microRNA expression using microarray, RT-qPCR and next-generation sequencing platforms.

An urgent need for plant virus diagnostics exist in the local grape, fruit, vegetable and ornamental plant industries. Our group provides a service (ViroNostix) where we develop diagnostic assays for virus pathogens in these crops.

Postgraduate students

Postdoctoral fellows

Dr Dirk Stephan; Dr Chrystine Solofoharivelo; Dr Hano Maree

PhD students

R. Lamprecht (2009 -). Construction of a South African Grapevine fanleaf virus deconstructed VIGS vector for analysis of Vitis vinifera gene function.

M. Snyman (2010 -). Characterisation of miRNA expression profiles in response to phytoplasma infection in grapevine.

M. Visser (2011 -). A metagenomic sequencing approach to elucidate the etiology of citrus virus diseases.

L.-A. Matthews (2012 -). Genome-wide characterisation of the *Podosphaera leucotricha* population in the Western Cape region to understand apple powdery mildew in South Africa.

S. Cornelissen (2012 -). Defining the QTL for chill and heat requirement during dormancy and dormancy release in apple (*Malus x domestica* Borkh.).

MSc students

R. Carstens (2009 -). The epidemiology of grapevine yellows disease in South African vineyards.

W. de Koker (2010 -). An investigation into the incidence of GVE in South African vineyards.

R. Bester (2011 -). Complete nucleotide sequence and evaluation of detection techniques of a new strain of GLRaV-3 detected in South African vineyards.

Y. Nel (2011 -). A profile of endophytic fungi and mycoviruses from Shiraz disease plants.

N. Spinas (2011 -). The effect of antimicrobial peptides on the grapevine pathogen Aster Yellows.

Selected publications

- Visser, M., Stephan, D., Jaynes, J.M., Burger, J.T. (2012). A transient expression assay for the *in planta* efficacy screening of an antimicrobial peptide against grapevine pathogens. *Letters in Applied Microbiology*, DOI 10.1111/j.1472-765X.2012.03244.x.
- Bester R, Maree H.J., Burger J.T. (2012). Complete nucleotide sequence of a new strain of grapevine leafroll-associated virus 3 in South Africa. Arch Virol, DOI 10.1007/s00705-012-1333-8.
- Lamprecht, R.L., Maree, H.J., Stephan, D., Burger, J.T. (2012). Complete nucleotide sequence of a South African isolate of Grapevine fanleaf virus. Virus Genes, DOI 10.1007/s11262-012-0765-2.
- Carstens, R., Petersen, Y., Stephan, D., Burger, J.T. (2012). Current status of Aster yellows disease in South African vineyards. Phytopathogenic Mollicutes 1(2):83-85.
- Jooste, A.E.C., Pietersen, G. & Burger, J.T. (2011). Distribution of grapevine leafroll associated virus-3 variants in South African vineyards. Eur. Jnl. Plant Path., 131(3): 371-381.
- Stephan, D., Slabber, C., George, G., Ninov, V., Francis, K.P., Burger, J.T. (2011). Visualization of plant viral suppressor silencing activity in intact leaf lamina by quantitative fluorescent imaging. *BMC Plant Methods* 7: 25.
- Du Preez J, Stephan D, Mawassi M, Burger J.T. (2011). The grapevine-infecting vitiviruses, with particular reference to grapevine virus A. *Arch Virol* 156, 9: 1495-1503. *Review*.
- Engelbrecht, M., Joubert, J. & Burger, J.T. (2010). Detection and molecular characterisation of Aster Yellows Phytoplasma in Grapevines (Vitis vinifera) in South Africa. – Plant Disease 94, 3: 373. DOI: 10.1094/PDIS-94-3-0373A.
- Coetzee, B., Freeborough, M.-J., Maree, H.J., Celton, J.-M., Rees, D.J.G & Burger, J.T. (2010). Deep sequencing analysis of viruses infecting grapevines: Virome of a vineyard, Virology 400(2):157-163.
- Coetzee, B., Maree, H.J., Stephan, D., Freeborough, M.-J., & Burger, J.T. (2010). The first complete nucleotide sequence and detection of subgenomic RNAs of a Grapevine virus E variant. Archives of Virology,155: 1357-60.

- Maree, H.J., Gardner, H.F.J., Freeborough, M.-J., & Burger, J.T. (2010). Mapping of the 5'-terminal nucleotides of Grapevine leafroll-associated virus 3' sgRNAs. Virus Research, 151, 252-255.