EMY TIYO MANO

IDENTIFICAÇÃO DE GENES DE *Burkholderia* sp. ASSOCIADOS AO CONTROLE BIOLÓGICO DE *Pectobacterium carotovora*

Dissertação apresentada ao Programa de Pós-Graduação Interunidades em Biotecnologia USP/Instituto Butantan/IPT, para obtenção do Título de Mestre em Biotecnologia**.**

Área de concentração: Biotecnologia

Orientador:
Prof. Dr. Welington Luiz Araújo

São Paulo
2011

RESUMO

MANO, E. T. **Identificação de genes de *Burkholderia* SP. associados ao controle biológico de *Pectobacterium carotovora***, 2011. 99 f. Dissertação (Mestrado em Biotecnologia) – Instituto de Ciências Biomédicas, Universidade de São Paulo, São Paulo, 2011.

A bacteria *Pectobacterium carotovora* causa danos a diferentes hospedeiros por meio da produção de enzimas pectinolíticas que degradam o pectato de cálcio da lamela media próximo a parede celular, causando extravasamento do conteúdo celular e consequentemente a podridão mole. Em orquídeas, as lesões ocorrem inicialmente nas folhas e avançam sobre os tecidos até atingir o pseudocaule, causando a morte da planta. Sua virulência é dependente das interações com o seu hospedeiro, com outros microrganismos, e com o ambiente. Resultados recentes demonstraram que bactérias endofíticas do gênero *Burkholderia* são capazes de controlar a podridão mole em orquídeas, e tem sido observado em *Oncidium* que a aplicação da bactéria pode reduzir em até 100% os sintomas da podridão mole. No entanto, os aspectos moleculares envolvidos neste controle ainda não foram estudados. Neste trabalho, 602 em um total de 1788 transformantes foram caracterizados quanto a sua habilidade em inibir os sintomas da podridão mole causada pela *P. carotovora.* , onde foram observados 16 mutantes com alteração no padrão de inibição e/ou a perda da capacidade total em controlar a doença quando comparado à linhagem selvagem. Entre estes mutantes foram encontrados sete diferentes genes inativados pelo transposon, sendo estes: região intermediária de uma proteína semelhante à patatina; glicosiltransferase; proteína hipotética com sequências traço do 23S rRNA; glutamato sintase; proteína transportadora da família facilitadora principal; poli-beta-hidroxialcanoato depolimerase e ácido graxo desaturase. Estes genes podem estar envolvidos em processos de síntese de aleloquímicos, competição por nutrientes, adaptação a condições ambientais, e na interação com o hospedeiro e/ou entre microrganismos. No entanto, o envolvimento destes genes na perda da capacidade em controlar a podridão mole deve ser melhor estudado.

Palavras-chave: *Burkholderia*. Controle biológico. Transposon Tn5. Podridão mole. Clonagem gênica.

ABSTRACT

MANO, E. T. **Identification of genes of *Burkhoderia* sp. associated with biological control of *Pectobacterium carotovora.*** 2011. 99 p. Master Thesis (Biotechnology) – Instituto de Ciências Biomédicas, Universidade de São Paulo, São Paulo, 2011.

The bacterium *Pectobacterium carotovora* cause damage to different hosts and by production of pectic enzymes that degrade calcium pectate of the middle lamella near of the cell wall, causing overflow of cell content and consequently the soft rot. In *Orchids*, the lesions occur initially in the leaves by tissues macerating , and reach the pseudo-stem causing the plant death. The virulence depend on the interactions the pathogen and the host plant as well as with other microorganisms, and the environment. Recent results has show that endophytic bacteria belonging to *Burkholderia* genus were able to control the soft rot in *Orchids*, and has been observed in *Oncidium* that the application of these bacteria reduce up to 100% the soft rot symptoms. However, the molecular aspects involved in the control have not been studied. In this work, 602 of a total 1788 transformants were characterized for their ability to inhibit soft rot caused by *P. carotovora*. We identified 16 mutants showing shifts in inhibition pattern or lost of the ablitity to inhibit soft rot symptoms. Among these mutants, we identified 7 genes related to disease inhibition: phospholipase like patatin protein region intermediate; glycosiltransferase protein; hypothetical protein with 23S rRNA sequences traces; glutamate synthase; major facilitator transporter protein; poli-beta-hidroxyalkanoate depolymerase; and fatty-acid desaturase. These genes may be involved in process of allelochemicals synthesis, competition for nutrients, adapting to environmental conditions, and interaction between the host and microorganisms. However, the involvement of these genes in loss of ability to control the soft rot disease is being further studied in details.

Key words: *Burkholderia*. Biological control. Transposon Tn5. Soft rot. Cloning gene.

1 INTRODUÇÃO

As orquídeas constituem um dos mais apreciados grupos de plantas ornamentais exploradas comercialmente no Brasil, sendo que, dentre os setores agrícolas em fase de expansão, seu cultivo vem se destacando. No entanto, essa intensificação na produção visando atender a demanda no mercado, resultou em um aumento no ataque de várias doenças e pragas. A implantação de monoculturas, manejo inadequado, incluindo a reciclagem de água de irrigação, eliminação de inimigos naturais por aplicação de produtos químicos não seletivos, mudanças de temperatura e umidade, resultam em alterações físicas, químicas e biológicas, que podem tornar a cultura vulnerável ao ataque de patógenos.

A podridão mole causada pela bactéria *Pectobaterium carotovora* é citada como uma das principais doenças encontradas em orquídeas. Estas bactérias infectam a planta hospedeira geralmente sobre alta umidade, onde produzem enzimas que degradam os pectados de cálcio da lamela média junto à parede celular, resultando em danos celulares com derramamento do conteúdo celular e necrose do tecido. Esta bactéria é um patógeno oportunista, e a sua virulência é dependente das interações com seu hospedeiro e microrganismos que ocupam o mesmo nicho, além da interação com o ambiente, como nutrientes e quantidade de água livre disponíveis, temperatura e tensão de oxigênio.

Atualmente, somente o controle químico, com custo elevado, tem apresentado resultados positivos na prevenção da podridão mole, mas é importante ressaltar o agravamento a longo prazo do uso intensivo de agroquímicos, tanto no aspecto da saúde humana como ao meio ambiente. No contexto de alternativas mais naturais para a contenção de patógenos, o controle biológico tem sido uma alternativa, principalmente quando empregado em conjunto com outros métodos, pois apresenta um menor custo e agressividade ao ecossistema comparado ao tratamento químico.

Experimentos em campo mostram que bactérias do gênero *Burkholderia* são capazes de colonizar uma variedade de plantas, aumentando significativamente o seu crescimento, além de reduzir a presença de patógenos. O controle biológico utilizando burkholderias poderia substituir parcialmente a utilização de pesticidas químicos comuns, visto que já foi relatada uma grande variedade de compostos com atividade antimicrobiana produzidos por *Burkholderia* sp., tais como cepacinas, pirrolnitrinas, cepaciamidas, cepacidinas, alteridinas, quinolonas, fenazinas, sideróforos e lipopeptídeos. Entretanto, o envolvimento destes metabólitos, assim como os mecanismos de controle não são bem conhecidos para esta

bactéria.

O controle de *P. carotovora* em *Oncidium flexuosum* foi demonstrado em estudo utilizando isolados endofíticos, onde apenas isolados de *Burkholderia* obtidos de eucalipto e cana-de-açúcar foram capazes de inibir o aparecimento dos sintomas da podridão mole em fragmentos foliares. Testes *in planta*, com a inoculação conjunta de *P. carotovora* e *Burkholderia* sp. resultaram no controle de 100% dos sintomas. Apesar do cenário favorável, existe uma baixa adoção do controle biológico em campo, em parte, por incerteza de sua eficácia, sendo necessário avaliar, por meio de estudos apropriados, os fatores que determinam o sucesso do agente de biocontrole. A supressão de doenças é resultado de uma interação complexa entre o antagonista, o patógeno, a planta hospedeira e a comunidade associada, além de fatores ambientais, sendo, portanto de grande interesse a sua compreensão.

Deste modo, este trabalho tem o intuito de identificar, por meio da obtenção e análise de uma biblioteca de mutantes gerados por mutagênese aleatória com o transposon Tn5, quais os possíveis mecanismos envolvidos no controle da podridão mole de *P. carotovora* por uma linhagem endofítica de *Burkholderia* sp. Os resultados obtidos poderão permitir uma melhor compreensão dos mecanismos envolvidos na complexa interação da tríade patógeno-hospedeiro-agente de controle biológico.

6 CONCLUSÃO

Por meio dos resultados obtidos no presente estudo, foram identificados 7 genes associados ao controle da podridão mole, com isso, foi possível concluir que:

- Isolados de *Burkholderia* spp. obtidos de cana de açúcar são capazes de controlar a podridão mole de *Oncidium* sp. causada por *P. carotovora,*

- A mutagênese aleatória por transposon constitui uma abordagem eficiente na identificação de genes envolvidos no controle da podridão mole de *Pectobacterium carotovora* pela linhagem de *Burkholderia cepacia* TC3.4.2R3 (O SEQUENCIAMENTO DO GENE Rec MOSTROU ISSO), permitindo gerar uma biblioteca de mutantes com perda da expressão de diferentes genes;

- O controle deste patógeno por *B. cenocepacia* TC3.4.2R3 em *Oncidium* ocorre por meio da produção de compostos aleloquímicos, competição por nutrientes, adaptação às condições ambientais, interação com a planta hospedeira, e entre microrganismos.

- Como perspectiva futura, um estudo mais aprofundado, a partir de uma análise mais específica e pontual para cada gene interrompido, auxiliarão no entendimento dos processos alterados nestes mutantes e a sua importância nas interações entre microrganismos em sistemas biológicos.

REFERÊNCIAS*

ADJEI, M. D.; OHTA, Y. Isolation and Characterization of a Cyanide-Utilizing *Burkholderia cepacia* Strain. **World Journal of Microbiology; Biotechnology**, v. 15, p. 699-704, 1999.

ADRIAN, P. V.; MENDRICK, C.; LOEBENBERG, D.; McNICHOLAS, P.; SHAW, K. J.; KLUGMAN, K. P.; HARE, R. S.; BLACK, T. A. Evernimicin (SCH27899) Inhibtis a Novel Ribosome Target Site: Analysis of 23S Ribosomal DNA Mutants. **Antimicrobial Agents and Chemotherapy**, v. 44, n. 11, p. 3101-3106, 2000.

ANDERSSON, R. A.; ERIKSSON, A. R. B.; HEIKINHEIMO, R.; MÄE, A.; PIRHONEN, M.; KÖIV, V.; HYYTIÄINEN, H.; TUIKKALA, A.; PALVA, T. Quorum Sensing in the Plant Pathogen *Erwinia cartovora* subsp. *caratovora*: The Role of expREcc. **Molecular Plant Microbe Interaction**, v. 13, p. 384-393, 2000.

ANDREWS, D. L.; BEAMES, B.; SUMMERS, M. D.; PARK, W. D. Characterization of the lipid acyl hydrolase activity of the major potato (*Solanum tuberosum*) tuber protein, patatin, by cloning and abundant expression in baculovirus vector. **Biochemical Journal**, v. 252, p. 199-206, 1988.

AVROVA, A. O.; HYMAN, L. J.; TOTH, R. L.; TOTH, I. K. Application of Amplified Fragment Length Polymorphism Fingerprinting for Taxonomy and Identification of the Soft Rot Bacteria *Erwinia carotovora* and *Erwinia chrysanthemi*. **Applied and Environmental Micriobiology**, v. 68, p. 1499-1508, 2002.

AZEVEDO, J. L.; MACCHERONI JR, W.; ARAÚJO, W. L. Importância dos microrganismos endofíticos no controle de insetos. In: MELO, I. S.; AZEVEDO, J. L. **Controle biológico.** Embrapa Meio Ambiente, Jaguariúna, São Paulo, 2000. v. 3, p. 57-87.

BAKKER, P. A. H. M.; RAN, L. X.; PIETERSE, C. M. J.; VAN LOON, L. C. Understanding the Involvement of Rhizobacteria-mediated Induction of Systematic Resistence in Biocontrol of Plant Diseases. **Canadian Journal Plant Pathology**, v. 25, p. 5-9, 2003.

---

* De acordo com:
ASSOCIAÇÃO BRASILEIRA DE NORMAS TÉCNICAS. **NBR 6023**: informação e documentação: referências:elaboração. Rio de Janeiro, 2002.

BAMKEKE, F. V.; BALZI, E.; TULKENS, P. M. Antibiotic Efflux Pumps. **Biochemical Pharmacology**, v. 60, p. 457-470, 2000.

BARBOSA, A. S.; LIN, C. J. Silenciamento de Genes com RNA Intererência: Um Novo Instrumento para Investigação da Fisiologia e Fisiopatologia do Córtex Adrenal. **Arquivo Brasileiro de Endocrinologia e Metabologia**, v. 48, p. 612-619, 2004.

BASNAYAKE, W. V. S.; BIRCH, R. G. A Gene from *Alcaligenes denitrificans* that Confers Albicidin Resistence by Reversible Antibiotic Binding. **Microbiology**, v. 141, p. 551-560, 1995.

BAUER, D. W., BOGDANOVE, A. J., BEER, S. V., AND COLLMER, A. *Erwinia chrysanthemi hrp* Genes and their Involvement in Soft Rot Pathogenesis and Elicitation of the Hypersensitive Response. **Molecular Plant Microbe Interactions**, v. 7, p. 573-581, 1994.

BENHAMOU, N.; KLOEPPER, J. W.; QUADT-HALMANN, A.; TUZUN, S. Induction of Defense-Related Ultrastructural Modification in Pea Root Tissues Inoculated with Endophytic Bacteria. **Plant Physiology**, v. 112, p. 919-929, 1996.

BEVININO, A.; DALMASTRI, C.; TABACCHIONI, S.; CHIARINI, L. Efficacy of *Burkholderia cepacia* MC17 in Disease Supression and Growth Promotion of Maize. **Biology and Fertility of Soils**, v. 31, p. 225-231, 2000.

BLAHA, G.; GUREL, G; SCHROEDER, S. J.; MOORE, P. B.; STEITZ, T. A. Mutations Outside the Anisomycin-Binding Site can Make Ribosomes Drug-Resistent. **Journal Molecular Biology**, v. 379, p. 505-519, 2008.

BLÉE, E. Phytooxylipins and plant defense reactions. **Progress in Lipid Research**, v. 37, p. 33-72, 1998.

BOBKOVA, E. V.; YAN, Y. P.; JORDAN, D. B.; KURILLA, M. G.; POMPLIANO, D. L. Catalytic Properties of Mutant 23S Ribosomes Resistant to Oxazolidinones. **The Journal of Biological Chemistry**, v. 278, n. 11, p. 9802-9807, 2003.

BOLWELL, G. P.; WOJTASZEK, P. Mechanisms for the Generation of Reactive Oxygens

Species in Plant Defence – Broad Perspective. **Physiological and Molecular Plant Pathology,** v. 51, p. 347-366, 1997.

BORODINA, I.; SCHOLLER, C.; ELIASSON, A.; NIELSEN, J. Metabolic Network Analysis of *Streptomyces tenebrarius*, a *Streptomyces* Species with a Active Entner-Doudoroff pathway. **Applied and Environmental Microbiology**, v. 71, n. 5, p. 2294-2302, 2005.

BOSGELMEZ-TINAZ, G. Quorum Sensing in Gram-negative Bacteria. **Turkey Journal Biology**, v. 27, p. 85-93, 2003.

BREDJA, J. J.; KREMER, R. J.; BROWN, J. R. Indications of associative nitrogen fixation in eastern gamagrass. **Journal.Range Manage**, v. 47, p. 192–95, 1994.

BRENCIC, A.; WINANS, S. C. Detection of and Response to Signals Involved in Host-Microbe Interactions by Plant-Associated Bacteria. **Microbiology and Molecular Biology Reviews**, v. 69, p. 155-194, 2005.

BURKHEAD, K. D.; SHISLER, D. A.; SLININGER, P. J. Pyrrolnitrin Production by Biological Control Agent *Pseudomonas cepacia* B37w in Culture and in Colonized Wounds of Potatoes. **Applied and Environmental Microbiology,** v. 60, p. 2031-2039, 1994.

BURSE, A.; WEINGART, H.; ULLRICH, M. S. *NorM*, an *Erwinia amylovora* Multidrog Efflux Pump Involved in *In Vitro* Competition with Other Epiphytic Bacteria. **Applied and Environmental Microbiology**, v. 70, n. 2, p. 693-703, 2003.

BUYER, J. S.; SIKORA, L. J. Rhizosphere Interactions and Siderophores. **Plant and Soil**, v. 129, p. 101-107, 1990.

CAIN, C. C.; HENRY, A. T.; WALDO, R. H.; CASIDA JR., L. J.; FALKINHAM, J. O. Identification and Characteristics of a Novel Burkholderia Strain with Broad-spectrum Antimicrobial Activity. **Applied and Environmental Micriobiology,** v. 66, p. 4139-4141, 2000.

CAMPOS, D. M. **Orquídeas**: Pragas e Doenças. 2. ed. Rio de Janeiro: Expressão e Cultura,

2002.

CAMPOS, D. A.; FERREIRA, A. G.; HAMPE, M. M. V.; ANTUNES, I. F.; BRANCÃO, N.; SILVEIRA, E. P.; SILVA, J. B.; OSÓRIO, V. A. Induction of Chalcone Synthase and Phenylalanine Ammonia-lyase by Salicilic Acid and *Colletotrichum lindemuthianum* in Common Bean. **Brazilian Journal Plant Physiology**, v. 15, n. 3, p. 129-134, 2003.

CAVE, G. L.; THOMAS, W. E. Risk Analysis of the Importation of Moth Orchid, *Phalaenopsis* sp., Plants in Approved Growing Media from Taiwan into the United States. **Animal an Plant Health Inspections Service. Plant Protection and Quarantine**, p. 1-34, 2003.

CHIA-HUI, L.; JIAN-CHENG, L.; VENKATESH, P.; HSIN-HAO, H.; SU-JUAN, Y.; JENT-TURN, L.; NING-SUN, Y.; HSIANG-EN, H.; TENG-YUNG, F.; WEN- HUEI, C.; MING-TSAIR, C. The Sweet Pepper Ferredoxin-like Protein (*pflp*) Conferred Resistance Against Soft Rot Disease in *Oncidium* Orchid. **Transgenic Research**, v. 12, p. 329-336, 2003.

CHIARINI, L.; BEVIVINO, A. M.; DALMASTRI, C.; TABACCHIONI, S.; VISCA, P. *Burkholderia cepacia* Complex Species: Health Hazards and Biotechnological Potential. **Trends In Microbiology**, v. 14, p. 277-286, 2006.

COENYE, T.; MAHENTHIRALINGAM, E.; HENRY, D.; LIPUMA, J. L.; LAEVENS, S.; VANDAMME, P. *Burkholderia ambifaria* sp. nov., a Novel Member of *Bulkholderia cepacia* Complex Including Biocontrol and Cystic Fibrosis-Related Isolates. **Internacional Journal of Systematic and Evolutionary Microbiology**, v. 51, p. 1481-1490, 2001a.

COENYE, T.; VANDAMME, P.; GOVAN, J. R. W.; LIPUMA, J. J. Taxonomy and identification of the *Burkholderia cepacia* complex. **Journal of Clinical Microbiology,** v. 39, p. 3427–3436, 2001b.

COENYE, T.; VANDAMME, P. Diversity and Significance of *Burkholderia* Species Occupying Diverse Ecological Niches. **Environmental Microbiology,** v. 9, p. 719-729, 2003.

COMPANT, S.; DUFFY, B.; NOWAK, J.; CLÉMENT, C.; BARKA, E. A. Use of Plant Growth-Promoting Bacteria for Biocontrol of Plant Diseases: Principles, Mechanisms of Action, and Future Prospects. **Apllied and Environmental Microbiology**, v. 71, p. 4951-

4959, 2005.

CONDON, C.; LIVERIS, D.; SOUIRES, C.; SCHWARTZ, I.; SQUIRES, C. L. rRNA Operon Multiplicity in *Escherichia coli* and the Physiological Implications of rrn Inactivation. **Journal of Bacteriology**, v. 177, n. 14, p. 4152-4156, 1995.

COVENTRY, H. S.; DUBERY, I. A. Lipopolysaccharides from Burkholderia cepacia Contribute to an Enhanced Defensive Capacity and the Induction of Pathogenesis-related Protein in Nicotianae tabacum. **Physiological and Molecular Plant Pathology**, v. 58, p. 149-158, 2001.

DANGL, J. L.; DIERICH, R. A.; RICHBERG, M. H. Death don't Have no mercy: Cell Death Programas in Plant-microbe interactions. **Plant Cell**, v. 8, p. 1797-1807, 1996.

DAUGHTREY, M. L.; BENSON, D. M. Principles of Plant Health Management for Ornamental Plants. **Annual Reviews in Phytopathology**, v. 43, p. 141-169, 2005.

De BOER, S. H. Characterization of Pectolytic *Erwinias* as Highly Sophisticated Pathogens of Plants. **European Journal of Plant Pathology**, v. 109, p. 893-899, 2003.

DITTY, J. L.; HARWOOD, C. S. Charged Amino Acids Conserved in the Aromatic Acid/H+ Synporter Family of Permeases are Required for 4-Hydroxybenzoate Transporte by PcaK from *Pseudomonas putida*. **Journal of Bacteriology**, v. 184, n. 5, p. 1444-1448, 2002.

DHONDT, S.; GEOFFROY, P.; STELMACH, B. A.; LEGRAND, M.; HEITZ, T. Soluble phospholipase A_2 activity is induced before oxylipin accumulation in tobacco mosaic virus-infected tobacco leaves and contributed by patatin-like enzymes. **The Plant Journal**, v. 23, n. 4, p. 431-440, 2000.

DHONDT, S.; GOUZERH, G.; MULLER, A.; LEGRAND, M.; HEITZ, T. Spatio-temporal expression of patatin-like lipid acyl-hydrolases and accumulation of jasmonates in elicitor-treated tobacco leaves are not affected by endogeneous levels of salicycle acid. **The Plant Journal**, v. 32, p. 749-762, 2002.

DONG, Y.; ZHANG, X.; XU, J.; ZHANG, L. Insecticidal *Bacillus thuringiensis* Silences *Erwinia carotovora* Virulent by New Form of Microbial Antagonism, Signal Interference. **Applied and Envirornmental Microbiology**, v. 70, p. 954-960, 2004.

DOW, J. M.; FENG, J.; BARBER, C. E.; TANG, J.; DANIELS, M. J. Novel Genes Involved in the Regulation of Pathogenicity Factor Production Within the *rpf* Gene Cluster of *Xanthomonas campestris*. **Microbiology**, v. 146, p. 885-891, 2000.

DOW, M.; NEWMAN, M. A.; VON ROEPENACK, E. The Induction and Modulation of Plant Defense Responses by Bacterial Lipopolysaccharides. **Annual Review of Phytopathology,** v. 38, p. 241-261, 2000.

DUFF, J.; DALY, A. Orchid Diseases in the Northern Territory. **Agnote,** v. 13, p. 1-5, 2002.

DUFFY, B.; SHOUTEN, A.; RAAIJMAKERS, J. M. Pathogen Self-Defense: Mechanisms to Counteract Microbial Antagonism. **Annual Reviews in Phytopathology**, v. 41, p. 501-538, 2003.

ERIKSSON, A. R. B.; ANDERSSON, R. A.; PIRHONEN, M.; PALVA, E. T. Two-component Regulators Involved in the Global Control of Virulence in *Erwinia carotovora* subsp. *carotovora*. **Molecular Plant-Microbe Interactions**, v. 11, p. 743-752, 1998.

EXPERT, D. Withholding and Exchanging Iron: Interaction Between *Erwinia* ssp. and their Plant Hosts. **Annual Review of Phytopathology**, v. 37, p. 307-334, 1999.

FAST, W. Molecular Radio Jamming: Autoinducer Analogs. **Chemistry Biology**, v. 10, p. 1-3.

FILONOW, A. B.; VISHNIAC, H. S.; ANDERSON, J. A.; JANISIEWICZ, W. J. Biological Control of *Botrytis cineria* in Aple by Yeasts from Various Habitats and their Putative Mechanisms of Antagonism. **Biological Control**, v. 7, p. 212-220, 1996.

GEORGAKOPOULOS, D. G.; HENDSON, M.; PANOPOULOS, N. J.; SCHROTH, M. N. Cloning of a Phenazine Biosynthetic Locus of *Pseudomonas aureofaciens* PGS12 and Analysis of Its Expression *in Vitro* with the Ice Nucleation Reporter Gene. **Applied and**

Environmental Microbiology, v. 60, p. 2931-2938, 1994.

GERHARDSON, B. Biological Substitutes for Pesticides. **Trends in Biotechnology,** v. 20, p. 338-343, 2002.

GONG, H.; BYERS, D. M. Glutamate-41 of *Vibrio harveyi* acyl carrier protein is essencial for fatty acid synthase but not acyl-ACP synthetase Activity. **Biochemical and Biophysical Research Communications,** v. 302, n. 1, p. 35-40, 2003.

GORYSHIN, I. Y.; REZNIKOFF, W. Tn5 *in Vitro* Transposition. **The Journal of Biological Chemistry**, v. 273, p. 7367-7374, 1998.

GORYSHIN, I. Y.; JENDRISAK, J.; HOFFMAN, L. M.; MEIS, R.; REZNIKOFF, W. S. Insertional Transposon Mutagenesis by Electroporation of Released Tn5 Transposition Complexes. **Nature Biotechnology**, v. 18, p. 97-100, 2000.

GRANT, S. N.; JESSEE, J.; BLOOM, F. R.; HANAHAN, D. Differential Plasmid Rescue from Transgenic Mouse DNAs into *Escherichia coli* Methylation-Restriction Mutants. **Procedings National Academic Sciences**, v. 87, p. 4645-4649, 1990.

GREGORY, S. T.; CATE, J. H. D; DAHLBERG, A. E. Spontaneous Erythromycin Resistence Mutation in a 23S rRNA Gene, rrlA, of the Extreme Thermophile *Thermus thermopiles* IB-21. **Journal of Bacteriology**, v. 183, n. 14, p. 4382-4385, 2001.

HAMMER, P. E.; HILL, D. S.; LAM, S. T.; VAN PÉE, K.; LIGON, J. M. Four Genes from *Pseudomonas fluorecens* that Encode the Biosynthesis of Pyrrolnitrin. **Applied and Environmental Microbiology**, v. 63, p. 2147-2154, 1997.

HAAS, D.; KEEL, C.; REIMMANN, C. Signal Transduction in Plant-beneficial Rhizobacteria with Biocontrol Properties. **Antonie van Leeuwenhoek**, v. 81, p. 385-395, 2002.

HAUBEN, L; MOORE, E. R. B.; VAUTERIN, L.; STENACKERS, M.; MERGAERT, J.; VERDONCK, L.; SWINGS, J. Phylogenetic Position of Phytopathogens within the *Enterobacteriaceae*. **Systematic and Applied Microbiology**, v. 21, p. 384-397, 1998.

HAYES, F. Transposon-Based Strategies for Microbial Functional Genomics and Proteomics. **Annual Reviews in Genetics**, v. 37, p. 3-29, 2003.

HEUNGENS, K.; PARKE, J. L. Postinfection Biological Control of Oomycete Pathogens of Pea by *Burklholderia cepacia* AMMDR1. **Phytopathology**, v. 91, p. 383-391, 2000.

HILL, D. S.; STEIN, J. L.; TORKEWITZ, N. R.; MORSE, A. M.; HOWELL, C. R.; PACHLATKO, J. P.; BECKER, J. O.; LIGON, J. M. Cloning of Genes Involved in the Synthesis of Piyrrolnitrin from *Pseudomonas fluorescens* and Role of Pyrrolnitrin Synthesis in Biological Control of Plant Disease. **Applied Environmental Microbiology**, v. 60, p. 78-85, 1994.

HIRSCHBERG, H. J. H. B; SIMONS, J. F. A.; DEKKER, N.; ERGMOND, M. R. Cloning , expression, purification and characterization of patatin, a novel phospholipase A. **European Journal Biochemistry**, v. 268, p. 5037-5044, 2001.

HOLEVA, M. C.; BELL, K. S.; HYMAN, L. J.; AVROVA, A. O.; WHISSON, S. C.; BIRCH, P. R. J.; TOTH, K. Use of a Pooled Transposon Mutation Grid to Demonstrate Roles in Disease Development for *Erwinia carotovora* subsp. *atroseptica* Putative Type III Secreted Effector (DspE/A) and Helper (HrpN) Proteins. **Molecular Plant Microbe Interactions**, v. 17, p. 943-950, 2004.

HOLMES, A.; GOVAN, J.; GOLDSTEIN, R. Agricultural Use of *Burkholderia* (*Pseudomonas*) *cepacia*. A Threat to Human Health? **Emerging Infectious Diseases**, v. 4, p. 221-227, 1998.

HUANG, Z.; BONSALL, R. F.; MAVRODI, D. V.; WELLER, D. M.; THOMASHOW, L. S. Transformation of *Pseudomonas fluorescens* with Genes for Biosynthesis of Phenazine-1-carboxylic Acid Improves Biocontrol of Rhizoctonia Root and in Situ Antibiotic Production. **FEMS Microbiology Ecology,** v. 49, p. 243-251, 2004.

HUANG, Y.; WRONG, P. T. W. Effect of *Burkholderia* (*Pseudomonas*) cepacia and Soil Type on the Control of Crow Rot in Wheat. **Plant and Soil**, v. 203, p. 103-108, 1998.

HUNT, T. A.; KOOI, C.; SOKOL, P. A.; VALVANO, M. A. Identification of *Burkholderia cenocepacia* Genes Required for Bacterial Survival in Vivo. **Infection and Immunity**, v. 72,

n. 7, p. 4010-4022, 2004.

HWANG, J.; BENSON, D. M. Biocontrol of Rhizoctonia Stem and Root Rot of Poinsettia with *Burkholderia cepacia* and Binucleate *Rhizoctonia*. **Plant Disease**, v. 86, p. 47-53, 2002.

HYYTIÄINEN, H. **Regulatory Networks Controlling Virulence in the Plant Pathogen *Erwinia carotovora* ssp. *carotovora***. 2005. 57 f. Tese (Mestrado) - Faculty of Biosciences, University of Helsinki, Helsinki, Finland, 2005.

KADOURI, D.; JURKEVITCH, E.; OKON, Y.; CASTRO-SOWINSKI, S. Ecological and Agricultural Significance of Bacterial Polyhydryalkanoates. **Critical Reviews in Microbiology**, v. 31, p. 55-67, 2005.

KAMPF, A. N. A. Floricultura Brasileira em Números. **Revista Brasileira de Horticultura Ornamental**. Campinas, v. 3, p. 1-7, 1997.

KANCHROO, P.; SHANKLIN, J.; SHAH, J.; WHITTLE, E. J.; KLESSIG, D. F. A Fatty Acid Desaturase Modulates the Activation of Defense Signaling Pathways in Plants, **PNAS**, v. 98, n. 16, p. 9448-9453, 2001.

KANG, Y.; CARLSON, R.; THARPE, W.; SCHELL, M. Characterization of Genes Involved in Biosysnteses of a Novel Antibiotic from *Burkholderia cepacia* BC11 and Their Role in Biological Control of *Rhizoctonia solani*. **Applied and Environmental Microbiology,** v. 64, p. 3969-3947, 1998.

KAPITONOV, D.; YU, R. K. Conserved Domains of Glycosyltransferases. **Glycobiology Oxford**, v. 9, n. 10, p. 961-978, 1999.

KEEL, C.; SCHNIDER, U.; MAURHOFER, M.; VOISARD, C.; LAVILLE, J.; BURGER, U.; WIRTHNER, P.; HAAS, D.; DÉFAGO, G. Supression of Root Diseases by *Pseudomonas fluorescens* CHA0: Importance of the Bacterial Secondary Metabolite 2,4-Diacetylphloroglucinol. **Molecular Plant-Microbe Interactions,** p. 54-13, 1999.

KESSLER, B.; WITHOLT, B. Factors involved in the Regulatory Network of Polyhydroxyalkanoate Metabolism. **Journal of Biotechnology**, v. 86, p. 97-104, 2001.

KIM, K. S.; KANG, J. O.; EUN, C. S.; HAN, D. S.; CHOI, T. Y. Mutations in the 23S rRNA Gene of *Helicobacter pylori* Associated with Clarithomycin Resistance. **Journal Korean Medical Science**, v. 17, p. 599-603, 2002.

KOLTER, R.; INUZUKA, M.; HELINSKI, D. R. **Trans-complementation Dependent Replication of a Low Molecular Weight Origin Fragment from Plasmid R6K**. Cell, Cambridge, v. 15, p. 1199-1208, 1978.

KOMATSU, H.; IMURA, Y.; OHORI, A.; NAGATA, Y.; THUSA, M. Distribuition and Organization of Auxotrophic Genes on the Multichromosomal Genome of *Burkholderia multivorans* ATCC17616. **Journal of Bacteriology**, v. 185, n. 11, p. 3333-3343, 2003.

KOTRA, L. P.; HADDAD, J.; MOBASHERY, S. Aminoglycosides: Perspectives on Mechanisms of Action and Resistence and Strategies to Counter Resistence. **Antimicrobial Agents and Chemotherapy**, v. 44, n. 12, p. 3249-3256, 2009.

KUC, J. Development and Future Direction of Induced Systemic Resistance in Plants. **Crop Protection**, v. 19, p. 859-861, 2000.

KUKLINSKY-SOBRAL, J.; ARAÚJO, W. L.; MENDES, R.; GERALDI, I. O.; PIZZIRANI-KLEINER, A. A.; AZEVEDO, J. L. Isolation and Characterization of Soybean-associated Bacteria and their Potencial for Plant Growth Promotion. **Environmental Microbiology,** v. 6, p. 1244-1251, 2004.

KUMAR, S.; TAMURA, K.; NEI, M. MEGA: Molecular Evolutionary Genetics Analysis Software for Computers. **Computer Applied Biosciences,** v. 10, n. 2, p. 189-191, 2004.

KUSANO, T.; SUGAWARA, K. Specific Binding of *Thiobacillus ferrooxidans RbcR* to the Intergenic Sequence Between the *rbc* Operon and the rbcR Gene. **Journal of Bacterioloy**, v. 175, n. 4, p. 1019-1025, 1993.

KUSANO, T.; TAKESHIMA, T.; INOUE, C.; SUGAWARA, K. Evidence for Two Sets of Structural Genes Coding for Ribulose Biophosphate Carobylase in Thiobacillus ferrooxidans. **Journal of Bacteriology**, v. 173, p. 7317-7723, 1991.

LAIRSON, L. L.; HENRISSAT, B.; DAVIES, G. J.; WITHERS, S. G. Glycosyltransferases: Structures, Functions and Mechanisms. **Annual Reviews**, v. 77, p. 521-555, 2008.

LAMBERG, A.; NIEMINEN, S.; QIAO, M.; SAVILAHTI, H. Efficient Insertion Mutagenesis Strategy for Bacterial Genomes Involving Electroporation of in Vitro-Assembled DNA Transposition Complexes of Bacteriophage Mu. **Applied and Environmental Microbiology**, v. 68, p. 705-712, 2001.

LEMIEUX, M. J.; HUANG, Y.; WANG, D. The Structural Basis of Substrate Translocation by the *Escherichia coli* Glycerol-3-phosphate transporter: a Member of the Major Facilitator Superfamily. **Current Opinion in Structural Biology**, v. 14, p. 405-412, 2004.

LEROUGE, I.; VANDERLEYDEN, J. O-antigen Structural Variation: Mechanisms and Possible Roles in Animal/plant-microbe Interactions. **Microbiology Reviews**, v. 26, p. 17-47, 2001.

LESSIE, T. G.; HENDRICKSON, W.; MANNING, B.; DEVEREUX, R. Genomic Complexity and Plasticity for *Burkholderia cepacia.* **FEMS Microbiology Letters**, v. 144, p. 117-128, 1996.

LIIV, A.; O'CONNOR, M. Mutations in the Subunit Bridge Regions of 23S rRNA. **Journal of Biological Chemistry**, v. 281, n. 40, p. 29850-29862, 2006.

LONG, K. S.; POEHISGAARD; HANSEN, L. H.; HOBBIE, S. N.; BOTTGER, E. C.; VESTER, B. Single 23S rRNA mutations at the ribosomal peptidyl transferase centre confer resistence to valnemulin and other antibiotics in *Mycobacterium smegmatis* by perturbation of drug binding pocket. **Molecular Microbiology**, v. 71, n. 5, p. 1218-1227, 2009.

LOS, D. A.; MURATA, N. Membrana Fluidity and its Roles in the Perception of Environmental Signals. **Biochimica et Biophysica Acta**, p. 142-157, 2004.

LUVIZOTTO, D. M.; MARCON, J.; ANDREOTE, F. D.; DINI-ANDREOTE, F.; NEVES, A. A. C.; ARAÚJO, W. L.; PIZZIRANI-KLEINER, A. A. Genetic Diversity and Plant-growth Related Features of *Burkholderia* sp. From Sugarcane Roots. **World Journal of Microbiology; Biotechnology**, v. 26, p. 1829-1836, 2010.

DSMZ. **Approved Lists of Bacterial Names. Bacterial Nomeclature Up-to-date**. Braunscheweig, Alemanha. 2010. Disponível em: < http://www.dsmz.de/microorganisms/bacterial_nomenclature_info.php?genus=BURKHOLDERIA>. Acesso em: 08 out. 2010.

LUZHETSKYY, A.; VENTE, A.; BECHTHOLD, A. Glycosyltransferases involved in the Biosynthesis of Biologicaly Active Natural Products that Contain Oligosaccharides. **Molecular Biosystems**, v. 1, p. 117-126, 2005.

MAFIA, R. G.; ALFENAS, A. C.; VENTURA, G. M.; ALFENAS, R. F. Antracnose em *Paphiopedilum insigne* (Orchidaceae) Causada por *Colletotrichum gloeosporioides*. **Fitopatologia Brasileira**, v. 30, p. 436, 2005.

MAHENTHIRALIGAM, E.; BALDWIN, A.; VANDAMME, P. *Burkholderia cepacia* complex infection in patients with cystic fibrosis. **Journal of Medical Microbiology**, v. 51, p. 533-538, 2002.

MAHENTHIRALINGAM, E.; URBAN, T. A.; GOLDBERG, J. B. The multifarious, Multireplicon *Burkholderia cepacia* Complex. **Nature Reviews Microbiology,** v. 3, p. 144-156, 2005.

MAO, S.; LEE, S.; HWANGBO, H.; KIM, Y.; PARK, K.; CHA, G.; PARK, R.; KIM, K. Isolation and Characterization of Antifungal Substances from *Burkholderia* sp. Culture Broth. **Current Microbiology**, v. 53, p. 358-364, 2006.

MARCON, J. **Efeito de cana-de-açúcar geneticamente modificada sobre comunidades bacterianas**. 2007. Tese (Doutorado em Biotecnologia) - Instituto de Ciências Biológicas, Universidade de São Paulo, São Paulo, 2007.

MARITS, R., TSHUIKINA, M., PIRHONEN, M., LAASIK, E., MÄE, A. Regulation of the Expression of prtW::gusA Fusions in *Erwinia carotovora* subsp. *carotovora*. **Microbiology**, v. 148, p. 835-842, 1999.

MARTINS, K. M. **Avaliação microbiológica e epidemiológica de cepas do Complexo *Burkholderia cepacia* isoladas de pacientes com fibrose cística.** 2007. 80 f. Dissertação (Mestrado em Ciências) - Universidade de São Paulo, São Paulo, 2007.

MCEVOY, J. L., MURATA, H., CHATTERJEE, A. K. Molecular Cloning and Characterization of an *Erwinia carotovora* subsp. *carotovora* Pectin Lyase Gene that Responds to DNA-Damaging Agents. **Journal of Bacteriology**, v. 172, p. 3284-3289, 1990.

MELLO, C. C.; CONTE JR, D. Revealing the world of RNA interference. **Nature**, v. 431, n. 16, p. 338-342, 2004.

MENARD, A.; MONNEZ, C.; SANTOS, P. E.; SEGONDS, C.; CABALLERO-MELLADO, J.; LIPUMA, J. J; CHABANON, G.; COURNOVER, B. Selection of Nitrogen-fixing Deficient *Burkholderia vietnamensis* Strains by Cystic Fibrosis Patients: Involvement of *nif* Gene Deletions and Auxotrophic Mutations. **Environmental Microbiology**, v. 9, n. 5, p. 1176-1185, 2007.

MENDES, R. **Diversidade de Caracterização de Comunidades Microbianas Endofíticas Associadas a Cana-de-açúcar**. 2008. 119 f. Tese (Doutorado em Agronomia) - Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, 2008.

MERCADO-BLANCO, J.; BAKKER, P. A. H. M. Interactions Between Plants and Beneficial *Pseudomonas* sp.: Exploiting Bacterial Traits for Crop Protection. **Antonie van Leeuwenhoek**, v. 92, p. 367-389, 2007.

MEYER, S. L. F.; ROBERTS, F. P.; CARTA, L. K.; LUMSDEN, R. D.; MAO, W. Application od *Burkholderia cepacia* and *Trichoderma virens*, Alone and in Combinations, Against Meloidogyne incognita on Bell Pepper. **Nematropica**, v. 31, p. 75-86, 2001.

MILLER, K. J.; WOOD, J. M. Osmoadaptation by Rhizosphere Bacteria. **Annual Reviews in Microbiology**, v. 50, p. 101-136, 1996.

MINAMI, S. N. **Diversidade e Controle Biológico de *Pectobacterium carotovora* em Orquídeas Utilizando Bactérias Endofíticas.** 2006. 61 f. Dissertação (Mestrado em Biotecnologia) - Universidade de Mogi das Cruzes, Mogi das Cruzes, São Paulo, Brasil, 2006.

MORAES, L. M.; CAVALCANTE, L. C. D.; FARIA, R. T. Substratos para Aclimatização de Plântulas de *Dendrobium nobile* Lindl. (Orchidaceae) Propagadas *in vitro*. **Acta Scientiarum**, v. 24, p. 1397-1400, 2002.

MORGAN, J. A. W.; BENDING, G. D.; WHITE, P. J. Biological Costs and Benefits to Plant-Microbe Interactions in the Rhizoshere. **Journal of Experimental Botany**, v. 56, p. 1729-1739, 2005.

NACAMULLI, C.; BEVIVINO, A.; DALMASTRI, C.; TABACCHIONI, S.; CHIARINI, L. Perturbation of Maize Rrhizosphere Microflora Following Seed Bacterization with *Burkholderia cepacia* MCI7. **FEMS Microbiology Ecology**, v. 23, p. 183-193, 1997.

NALBANTOGLU, B. Analysis of Functional Domains on Glutamate Synthase. **Turkey Journal Biology**, v. 24, p. 197-213, 2000.

NOMURA, M.; MORGAN, E. A. Genetics of Bacterial Ribosomes. **Annual Reviews in Genetic,** v. 11, p. 297-347, 1977.

OJIAMBO, P. S.; SCHERM, H. Biological and Application-Oriented Factors Influencing Plant Disease Supression by Biological Control: A Meta-Analytical Review. **Phytopathology**, v. 96, p. 1168-1174, 2006.

ORMENO-ORRILLO, E.; ROSENBLUETH, M.; LUYTEN, E.; VANDERLEYDEN, J.; MARTINEZ-ROMERO, E. Mutations in Lipopolysaccharide Biosynthetic Genes Impair Maize Rhizosphere and Root Colonization of *Rhizobium tropici* CIAT899. **Environmental Microbiology**, v. 10, n. 5, p. 1271-1284, 2008.

PAIVA, E.; LISTER, R. M.; PARK, W. D. Induction and Accumulation of Major Tuber Protein in Stems and Petioles. **Plant Physiology**, v. 71, p. 161-168, 1983.

PAJUNEN, M. I.; PULLIAINEN, A. T.; FINNE, J.; SAVILAHTI, H. Generation of Transposon Insertion Mutant Libraries for Gram-positive Bacteria by Eletroporation of Phage Mu DNA Transposition Complexes. **Microbiology**, v. 151, p. 1209-1218, 2005.

PAO, S. S.; PAULSEN, I. T.; SAIER JR., M, H. Major Facilitator Superfamily. **Microbiology and Molecular Biology Reviews**, v. 62, n. 1, p. 1-34, 1998.

PARKE, J. L.; GURIAN-SHERMAN, D. Diversity of the *Burkholderia cepacia* Complex and Implications for Risk Assessment of Biological Control Strains. **Annual Reviews in**

Phytopathology. V. 39, p. 225-258, 2001.

PAKKER, W. L.; RATHNUM, M. L.; SEINER, V.; TREJO, W. H.; PRINCIPE, P. A.; SYKES, R. B. Cepacin A and B, Two New Antibiotics Produced by *Pseudomonas cepacia*. **The Journal of Antibiotics**, v. 37, p. 431-440, 1984.

PEMBERTON, C.; SALMOND, G. P. C. The Nep1-like Proteins - A Growing Family of Microbial Elicitors of Plant Necrosis. **Molecular Plant Pathology**, v. 5, p. 353–359, 2004.

PERIN, L.; MARTÍNEZ-AGUILAR, L.; CASTRO-GONZÁLEZ, R.; ESTRADA-DE LOS SANTOS, P.; CABELLOS-AVELAR, T.; GUEDES, H. V.; REIS, V. M.; CABALLERO-MELLADO, J. Diazotrophic *Burkholderia* Species Associated with Field-Grown Maize and Sugarcane. **Applied and Environmental Microbiology**, v. 72, p. 3103-3110, 2006.

PÉROMBELON, M. C. M.; KELMAN, A. Ecology of the Soft Rot Erwinias. **Annual Reviews in Phytopathology**, v. 18, p. 361-387, 1980.

PÉROMBELON, M. C. M.; WOLF, J. M. V. D. **Methods for the Detection and Quantification of *Erwinia carotovora* subsp. *atroseptica* (*Pectobacterium carotovorum* subsp. *atrosepticum*) on Potatoes: a Laboratory Manual**. Scottish Crop Research Institute, v. 10, 2002.

PIRHONEN, M.; SAARILAHTI, H.; KARLSSON, M. B.; PALVA, E. T. Identification of Pathogenicity Determinants of *Erwinia carotovora* subsp. *carotovora* by Transposon Mutagenesis. **Molecular Plant Microbe Interactions**, v. 4, p. 276-283, 1991.

RAAIJMAKERS, J. M.; PAULITZ, T. C.; STEINBERG, C.; ALABOUVETTE, C.; MOENNE-LOCCOZ, Y. The Rizosphere: a Playground and Battlefield for Soilborne Pathogens and Beneficial Microorganisms. **Plant Soil**, p. 1-21, 2008.

RAMETTE, A.; LIPUMA, J. J.; TIEDJE, J. M. Species Abundance and Diversity of *Burkholderia cepacia* Complex in the Environment. **Applied and Environmental Microbiology**, v. 71, p. 1193-1201, 2005.

RANKATARI, A.; VIRTAHARJU, O.; VÄHÄMIKO, S.; TAIRA, S.; PALVA, E. T.;

SAARILAHTI, H. T.; ROMANTSCHUK, M. Type III Secretion Contributes to the Pathogenesis of the Soft-Rot *Erwinia carotovora*: Partial Characterization on the hrp Gene Cluster. **Molecular Plant Microbe Interactions**, v. 14, p. 962-968, 2001.

REZNIKOFF, W. S. The Tn5 transposon. **Annual Review Microbiology**, v. 47, p. 945-963, 1993.

REZNIKOFF, W. S.; BHASIN, A.; DAVIES, D. R.; GORYSHIN, I. Y.; MAHNKE, L. A.; NAUMANN, T.; RAYMENT, I.; STEINIGER-WHITE, M.; TWINING, S. S. Tn5: A Molecular Window on Transposition. **Biochemical and Biophysical Research Communications**, v. 266, p. 729-734, 1999.

ROSENBLUETH, M.; MARTINEZ-ROMERO, E. Bacterial Endophytes and Their Interactions with Hosts. **Molecular Plant-Microbe Interactions**, v. 19, p. 827-837, 2006.

ROSSETTO, P. B. **Interações entre cana-de-açúcar e bactérias associadas**. 2008. 148 f. Tese (Doutorado em Agronomia) - Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, 2008.

SAMBROOK, J.; FRITISCH, E. F.; MANIATIS, T. **Molecular Cloning**: A Laboratory Manual. Local: Cold Spring Harbor Laboratory Press, 1989. 765 p.

SANTOS, P. E.; BUSTILLOS, R.; CABALLERO-MELLADO, J. (2001) *Burkholderia*, a Genus Rich in Plant-Associated with Wide Environmental and Geographic. **Applied and Environmental Micriobiology**, v. 67, p. 2790-2798, 2001.

SANTOS, V. C. P. **Atividade antibacteriana de *Burholderia* sp. endofíticas e da rizosfera de cana-de-açúcar**. 2010. 94 f. Tese (Doutorado em Agronomia) - Escola Superior de Agricultura "Luiz de Queiroz", Universidade de São Paulo, Piracicaba, 2010.

SATO, H.; FRANK, R. W.; HILLARD, C. J.; FEIX, J. B.; PANKHANIYA, R. R.; MORIYAMA, K.; FINCK-BARBANCON; BUCHAKLIAN, A.; LEI, M.; LONG, R. M.; WIENER-KRONISH, J.; SAWA, T. The Mechanism of Action of the *Pseudomonas aeruginosa*-enconded Type III cytotoxin, ExoU. **The EMBO Journal**, v. 22, n. 12, p. 2959-2969, 2003.

SEBRAE AGRONEGÓCIOS. Jardim de Oportunidades. **Revista Sebrae: Serviço Brasileiro de Apoio às Micro e Pequenas Empresas**, v. 1, out. 2005.

SOLAIMAN, D. K. Y.; ASHBY, R. D.; FOGLIA, T. A. Effect of Inactivation of Poly (hydroxyalkanoates) Depolymerase Gene on the Properties of Poly (hydroxyalkanoates) in *Pseudomonas resinovorans*. **Applied Microbiological Biotechnology**, v. 62, p. 536-543, 2003.

SCHULTZ, D. J.; SUH, M. C.; OHLROGGE, J. B. Stearoyl-Acyl Carrier Protein and Unusual Acyl-Acyl Carrier Protein Desaturase Activities are Differentially Influenced by Ferredoxin. **Plant Physiology**, v. 124, p. 681-692, 2000.

SCHWEIZER, H. P. Efflux as a Mechanism of Resistance to Antimicrobials in *Pseudomonas aeruginosa* and Related Bacteria: Unanswered Questions. **Genetic Molecular Research**, v. 2, n. 1, p. 48-62, 2003.

SHARYPOVA, L. A.; NIEHAUS, K.; SHEIDLE, H.; HOLST, O.; BECHER, A. Sinorhizobium melioti *acpXL* Mutant Lacks the C28 Hydroxylated Fatty Acid Moiety of Lipid A and Does Not Express a Slow Migrating Form of Lipopolysaccharide. **The Journal of Biological Biochemistry**, v. 278, n. 15, p. 12946-12954, 2003.

STASKAWICZ, B. J. Genetics of Plant-Pathogen Interactions Specifying Plant Disease Resistence. **Plant Physiology**, v. 125, p. 73-76, 2001.

STURZ, A. V.; CHRISTIE, B. R. Beneficial Microbial Allelopaties in the Root Zone: The Management of Soil Quality and Plant Disease with Rhizobacteria. **Soil; Tillage Research**, v. 72, p. 107-123, 2003.

SUZUKI, N.; OKAI, N.; NONAKA, H.; TSUGE, Y.; INUI, M.; YUKAWA, H. High-Throughput Transposon Mutagenesis of *Corynebacterium glutamicum* and Construction of a Single-Gene Disruptant Mutant Library. **Applied and Environmental Microbiology**, v. 72, p. 3750-3755, 2006.

THALER, J. S.; OWEN, B.; HIGGINS, V. J. The Role of the Jasmonate Response in Plant Susceptibility to Diverse Pathogens with a Range of Lifestyles. **Plant Physiology**, v. 135, p. 530-538, 2004.

TOTH, I. K.; BELL, K. S.; HOLEVA, M. C.; BIRCH, P. R. J. Soft-rot Erwinae: from Genes to Genomes. **Molecular Plant Pathology**, v. 4, p. 17-30, 2003.

TUNG, S. Y.; KUO, T. T. Requirement for Phosphoglucose Isomerase of *Xanthomonas campestris* in Pathogenesis of Citrus Canker. **Applied and Environmental Microbiology**, v. 65, p. 5564-5570, 1999.

UNLIGIL, U. M.; RINI, J. M. Glycosyltransferase Structure and Mechanism. **Current Opinion in Structural Biology**, v. 10, p. 510-517, 2000.

VALARINI, P. J. Desenvolvimento de Método e Indicadores de Avaliação do Impacto Ambiental das Práticas de Manejo em Sistemas de Produção Intensivos. **Boletim de Pesquisa e Desenvolvimento**. Jaguariúna: Embrapa Meio Ambiente, v. 36, p. 1-25, 2006.

VANLAERE, E.; BALDWIN, A.; GEVERS, D.; HENRY, D.; DE BRANDT, E.; LIPUMA, J. J.; MAHENTHIRALIGAM, E.; SPEERT, D. P.; DOWSON, C.; VANDAMME, P. Taxon K, a Complex Within the *Burkholderia cepacia* Complex, Comprises at Least Two Novel Species, *Burkholderia contaminans* sp. nov. and *Burkholderia lata* sp. nov. **International Journal of Systematic and Evolutionary Microbiology**, v. 59, p. 102-111, 2009.

VANLAERE, E.; LIPUMA, J. J.; BALDWIN, A.; HENRY, D.; DE BRANDT, E.; MAHENTHIRALINGAM, E.; SPEERT, D.; DOWSON, C.; VANDAMME, P. *Burkholderia latens* sp. nov., *Burkholderia diffusa* sp. nov., *Burkholderia arboris* sp. nov., *Burkholderia seminalis* sp. nov., *Burkholderia metallica* sp. nov. Novel Species Within the *Burkholderia cepacia* Complex. **International Journal of Systematic and Evolutionary Microbiology**, v. 58, p. 1580-1590, 2008.

VELUSAMY, P.; IMMANUEAL, J. E.; GNANAMANICKAM, S.S.; THOMASHOW, L. . Biological Controlo f Rice Bacterial Blight by Plant-associated Bactéria Producing 2,4-diacetylphloroglucinol. **Canadian Journal of Microbiology**, v. 52, p. 56-65, 2006.

VERMIS, K.; VANDEKERCKHOVE, C.; NELIS, H. J.; VANDAMME, P. A. R. Evaluation of Restriction Fragment Length Polymorphism Analysis of 16S rDNA as a Tool for Genomovar Characterisation Within the *Burkholderia cepacia* Complex. **FEMS Microbiology Letters**, v. 214, p. 1-5, 2002.

WALSH, C.; MEYERS, C. L. F.; LOSEY, H. C. Antibiotic Glycosyltransferases: Antibiotic Maturation and Prospects for Reprogramming. **Medical Chemistry**, v. 46, n. 16, p. 3425-3436, 2003.

WANG, C.; XU, A.; GAO, Y.; FAN, Y.; LIANG, Y.; ZHENG, C.; SUN, L.; WANG, W.; ZHAO, K. Generation and Characterisation of Tn5-tagged *Xanthomonas oryzae* p. *oryzae* mutants that overcome *xa23*-mediated resistance to bacterial blight of rice. **European Journal of Plant Pathology**, v. 123, n. 3, p. 343-351, 2008.

WARREN, A. S.; ARCHULETA, J.; FENG, W.; SETUBAL, J.C. Missing Genes in Annotation of Prokaryotic Genomes. **BMC Bioinformatics**, v. 11, p. 2-12, 2010.

WATANABE, K.; PRASEUTH, A. P.; WANG, C. C. C. A Comprehensive and Engaging Overview of the Type III Family of Polyketide Synthases. **Current Opinion in Chemical Biology**, v. 11, p. 279-286, 2007.

WEBER, M. H. W.; KLEIN, W.; MULLER, L.; NIESS, U. M.; MARAHIEAL, M.A. Role of the *Bacillus subtilis* Fatty Acid Desaturase in Membrane Adaptation During Cold Shock. **Molecular Microbiology**, v. 39, n. 5, p. 1321-1329, 2001.

WINKELMANN, G. **Microbial Siderophore-Mediated Transport**. Biometals 2002: Third International Biometals Symposium, 2002.

WOZNIAK, C. A. **Regulatory Review of *Burkholderia cepacia* under FIFRA**. USDA, Cooperative States Research, Education and Extension Service, 2006.

XIONG, L.; KLOSS, P.; DOUTHWAITE, S.; ANDERSEN, N. M.; SWANEY, S.; SHINABARGER, D. L.; MANKIN, A. S. Oxazolidinone Resistance Mutations in 23S rRNA of *Escherichia coli* Reveal the Central Region of Domain as the Primary Site of Drug Action. **Journal of Bacteriology**, v. 182, n. 19, p. 5325-5331, 2000.

ZAKI, K.; MISAGHI, I. J.; HEYDARI, A. Control of Cotton Seedling Damping-off in the Field by *Burkholderia* (Pseudomonas) *cepacia*. **Plant Disease**, v. 82, p. 291-293, 1998.

ZELLER, W. Status on Induced Resistence Against Plant Bacterial Diseases. **Fitossanidad**,

v. 10, p. 99-103, 2006.

ZHANG, L.; BIRCH, R. G. The Gene for Albicidin Detoxification from *Pantoea dispersa* Encodes an Esterase and Attenuates Pathogenicity of *Xanthomonas albilineans* to Sugarcane. **Procedings National Academics Science USA,** v. 94, p. 9984-9989, 1997.