



REFERENCES

- Abe K. and Arai S. (1985) Purification of a cysteine protease inhibitor from rice, *Oryza sativa* L. japonica. *Agriculture Biology and Chemistry*, 49, 3349-3350.
- Abe K., Emori Y., Kondo H., Suzuki K. and Arai S. (1987) Molecular cloning of a cysteine protease inhibitor of rice (oryzacystatin). Homology with animal cystatins and transient expression in the ripening process of rice seeds. *Journal of Biological Chemistry*, 262, 16793-16797.
- Abe M., Abe K., Domoto C. and Arai S. (1995) Two distinct species of corn cystatin in corn kernels. *Bioscience, Biotechnology and Biochemistry*, 59, 756-758.
- Abe M., Abe K., Kuroda M. and Arai S. (1992) Corn kernel cysteine protease inhibitor as a novel cystatin super family member of plant origin. Molecular cloning and expression studies. *European Journal of Biochemistry*, 209, 933-937.
- Abera A. M. K., Gold C.S. and Kyamanywa S. (1999) Timing and distribution of attack by the banana weevil (Coleoptera: Curculionidae) in East Africa highland banana (*Musa* spp.). *Florida Entomologist*, 82, 631-641.
- Abrahamson, M. (1994) Cystatins. In: *Methods in Enzymology* (Barrett, A. J. ed.). Academic Press, San Diego, pp. 685-700.
- Alpteter F., Diaz I., Mcauslane H., Gaddour K., Carbonero P. and Vasil I.K. (1999) Increased insect resistance in transgenic wheat stably expressing trypsin inhibitor. *Molecular Breeding*, 5, 53-63.
- Altschul S.F., Gish W., Miller W., Myers E.G. and Lipman D.J. (1990) Basic Local Alignment Search Tool. *Journal of Molecular Biology*, 215, 403-410.



- Annadana S., Peters J., Gruden K., Schipper A., Outchkourov N.S., Beekwilder M.J., Udayakumar M. and Jongsma M.A. (2002) Effects of cysteine protease inhibitors on oviposition rate of the western flower thrips, *Frankliniella occidentalis*. *Journal of Insect Physiology*, 48, 701–706.
- Applebaum S.W. (1985) Biochemistry of digestion. In: *Comprehensive Insect Physiology, Biochemistry and Pharmacology* (Kerkot, G.A. and Gilbert, L.I. (eds.)), New York, Pergamon Press 4, 279-311.
- Arai S., Watanabe H., Kondo H., Emori Y. and Abe K. (1991) Papain inhibitory activity of oryzacystatin, a rice seed cysteine protease inhibitor, depends on the central Gln-Val-Val-Ala-Gly region conserved among cystatin superfamily members. *Journal of Biochemistry*, 109, 294-298.
- Arai S. and Abe, K. (2000) Cystatin-based control of insects, with special reference to oryzacystatin. In: *Recombinant Protease Inhibitors in Plants* (Michaud, D., ed.). Georgetown, TX: Landes Bioscience, pp. 27–42.
- Arai S., Matsumoto, I., Emori, Y. and Abe, K. (2002) Plant seed cystatins and their target enzymes of endogenous and exogenous origin. *Journal of Agriculture and Food Chemistry*, 50, 6612–6617.
- Arinaitwe G. (2002) Genetic improvement of East African Highland Banana (*Musa* spp) via engineering for fungal disease resistance. In: *Novel Approaches to the Improvement of Banana Production in Eastern Africa- The Application of Biotechnological Methodologies Project Report (Annexes) INIBAP*, Montpellier France pp 45-53.
- Ashouri A., Michaud D. and Cloutier C. (2001) Recombinant and classically selected factors of potato plant resistance to the Colorado potato beetle, *Leptinotarsa*



decemlineata, variously affect the potato aphid parasitoid *Aphidius nigripes*.

Biocontrol 46: 401-18.

Atkinson H.J., Grimwood S. Johnston K. and Green J. (2004) Prototype demonstration of transgenic resistance to the nematode *Radopholus similis* conferred on banana by a cystatin. Transgenic Research, 13, 135–142.

Baker J.E., Woo S.M. and Mullen M.A. (1984) Distribution of proteinases and carbohydrates in the midgut of the larvae of the sweet potato weevil *Cyclas formicarius* and response of protease to inhibitors from sweet potato. Entomologia Experimentalis et Applicata, 36, 97-105.

Barbour K.W., Goodwin R.L., Guillonneau F., Wang Y., Baumann H. and Berger F.G. (2002) Functional diversification during evolution of the murine proteinase inhibitor family: role of the hypervariable reactive center loop. Molecular Biology and Evolution, 19, 718–727.

Barrett A.J. (1986) The classes of proteolytic enzymes. In: Plant proteolytic enzymes (Dalling, M.J. ed.), Florida, CRC Press Inc. vol. 1, p. 1-16.

Belenghi B., Acconcia F., Trovato M., Perazzolli M., Bocedi, A., Polticelli, F., Ascenzi, P. and Delledonne, M. (2003) AtCYS1, a cystatin from *Arabidopsis thaliana*, suppresses hypersensitive cell death. European Journal of Biochemistry, 270, 2593–2604.

Bent A.F. (1996) Plant disease resistance genes: Function meets structure. Plant Cell, 8, 1757-1771.

Bergey D.R., Orozco-Cardenas M., de Moura D. S. and Ryan C. A. (1999) A wound- and systemin-inducible polygalacturonase in tomato leaves. Proceedings of the National Academy of Sciences of the United States of America, 96, 1756-1760.



- Bielawski J.P. and Yang Z. (2003) Maximum likelihood methods for detecting adaptive evolution after gene duplication. *Journal of Structural and Functional Genomics*, 3, 201–212.
- Birk Y., and Applebaum Y. (1960) Effect of soybean trypsin inhibitors on the development and midgut proteolytic activity of *Tribolium castaneum* larvae. *Enzymologia Acta Biocatalytica*, 22, 318-326.
- Birkenmeier G.F. and Ryan, C.A. (1998) Wound signaling in tomato plants: evidence that ABA is not a primary signal for defense gene activation. *Plant Physiology*, 17, 687-693.
- Bishop J.G., Dean A.M. and Mitchell-Olds T. (2000) Rapid evolution in plant chitinases: molecular targets of selection in plant–pathogen coevolution. *Proceedings of the National academy of Sciences of the United States of America*, 97, 5322–5327.
- Bode W. and Huber, R. (2000) Structural basis of the endoproteinase–protein inhibitor interaction. *Biochimica et Biophysica Acta*, 1477, 241–252.
- Bode W., Engh R., Musil D., Thiele U., Huber R., Karshikov A., Brzin J., Kos J. and Turk, V. (1988) The 2.0 Å crystal structure of chicken egg white cystatin and its possible mode of interaction with cysteine proteinases. *EMBO Journal*, 7, 2593–2599.
- Boulter D. (1993) Insect pest control by copying nature using genetically engineered crops. *Phytochemistry*, 34, 1453-1466.
- Bown D.P., Wilkinson H.S. and Gatehouse, J.A. (1997) Differentially regulated inhibitor sensitive and insensitive protease genes from the phytophagous insect pest, *Helicoverpa armigera*, are members of complex multigene families. *Insect Biochemistry and Molecular Biology*, 27, 625-638.



- Broadway RM. (2000) The adaptation of insects to protease inhibitors. In: Recombinant Protease Inhibitors in Plants (Michaud, D. ed.), Landes Bioscience/Eurekah.com, Georgetown, TX pp. 80–88.
- Broadway R.M. and Duffey, S.S. (1986) Plant protease inhibitors: mechanism of action and effect on the growth and digestive physiology of larval *Heliothis zea* and *Spodoptera exigua*. *Journal of Insect Physiology*, 32, 827-833.
- Brovosky D. (1986) Proteolytic enzymes and blood digestion in the mosquito *Culex nigripalpus*. *Archives of Insect Biochemistry and Physiology*, 3, 47-160.
- Brunelle F., Nguyen-Quoc B., Cloutier C. and Michaud D. (1999) Protein hydrolysis by Colorado potato beetle, *Leptinotarsa decemlineata*, digestive proteases: the catalytic role of cathepsin D. *Archives of Insect Biochemistry and Physiology*, 42, 88-98.
- Bryant J., Green T.R. Gurusaddaiah T. and Ryan, C.A. (1976) Protease inhibitor II from potatoes: isolation and characterization of its promoter components. *Biochemistry*, 5, 3418-3424.
- Brzin J., Popovic T., Ritonja A., Puizdar V. and Kidric M. (1998) Related cystatin inhibitors from leaf and from seed of *Phaseolus vulgaris* L. *Plant Science*, 138, 17-26.
- Brzin J., Ritonja A., Popovic T. and Turk V. (1990) Low molecular mass protein inhibitor of cysteine proteinases from soybean. *Biological Chemistry Hoppe-Seyler*, 371, 167-170.
- Buddenburg W.J., Ndiege I.O., Karago F.W. and Hanson B.S.S. (1993) Behavioural and electrophysiological responses of the banana weevil *Cosmopolites sordidus* to host plant volatiles. *Journal of Chemical Ecology*, 19, 267-277.



- Burgess E.P.J. Steven P.S., Keen G.K., Laing W.A. and Christeller J.T. (1991) Effects of protease inhibitors and dietary protein level on the black field cricket *Teleogryllus commodus*. *Entomologia Experimentalis et Applicata*, 61, 123-130.
- Campos F.A.P., Xavier-Filho J., Silva C.P. and Ary M.B. (1989) Resolution and partial characterization of proteinases and α -amylases from midguts of larvae of the bruchid beetle *Callosobruchus maculatus* (F.). *Comparative Biochemistry and Physiology-B*, 92, 51-57.
- Carbonero P., Royo J., Díaz I., García-Maroto F., Gonzalez-Hidalgo E., Gutierrez C. and Casanera, P. (1993) Cereal inhibitors of insect hydrolases (α -amylases and trypsin): genetic control, transgenic expression and insect pests. In: *Workshop on engineering plants against pests and pathogens* (Bruening, G.J., García-Olmedo, F. and Ponz, F.J. eds.). Instituto Juan March de Estudios Investigaciones, Spain.
- Carlens K. (2002) Nematode control in East African regions by the transgenic banana (*Musa* spp.) expressing different types of lectins. In: *Novel Approaches to the improvement of banana production in Eastern Africa-the application of biotechnological methodologies Project Report (Annexes)* INIBAP, Montpellier France.
- Carlini C.R., Grossi-de-Sa, M.F., (2001) Plant toxic proteins with insecticidal properties. A review on their potentialities as bioinsecticides. *Toxicon*, 40, 1515-1539.
- Carreel F., Abadies C., Carlier K., Tomekpe K., Lagoda P.J.L. and Bakry F. (1999) Genome mapping and genetic analysis of the black leaf streak resistance in



banana. In: Abstracts of the International Symposium on the Molecular and Cellular Biology of banana, Ithaca, New York INIBAP.

Carter P. (1986) Site-directed mutagenesis. *Biochemistry Journal*, 237, 1-7

Charity J.A., Anderson Marilyn A., Bittisnich DJ., Whitecross M. and Higgins, T.J.V. Transgenic tobacco and peas expressing a protease inhibitor from *Nicotiana glauca* have increased insect resistance. *Molecular Breeding*, 5, 357-365.

Chen, M.S., Johnson B., Wen L., Muthukrishnan S., Kramer K.J., Morgan T.D., and Reeck G.R. (1992) Rice cystatin: bacterial expression, purification, cysteine protease inhibiting activity and insect growth suppressing activity of a truncated form of the protein. *Protein Expression and Purification*, 3, 41-49.

Chye M. L., Sin S.F., Xu Z.F. and Yeung E.C. (2006) Serine proteinase inhibitor proteins: exogenous and endogenous functions, *In Vitro Cellular and Development Biology – Plant*, 42, 100–108.

Cloutier C., Jean C., Fournier M., Yelle S., Michaud D. (2000) Adult colorado potato beetles, *Leptinotarsa decemlineata* compensate for nutritional stress on oryzacystatin I-transgenic potato plants by hypertrophic behaviour and overproduction of insensitive proteinases. *Archives of Insect Biochemistry and Physiology*, 44, 69-81.

Colella R., Sakaguchi Y., Nagase H. and Bird J.W. (1989) Chicken egg white cystatin. Molecular cloning, nucleotide sequence and tissue distribution. *Journal of Biological Chemistry*, 264, 17164-17169.

Collins P.J., Treverrow N.L. and Lambkin T.M. (1991) Organophosphorous insecticide resistance and its management in the banana weevil borer, *Cosmopolites sordidus* Germar (Coleoptera: Curculionidae) in Australia. *Crop Protection*, 10, 215-221.



- Creighton T.E. and Darby N.J. (1989) Functional evolutionary divergence of proteolytic enzymes and their inhibitors. *Trends in Biochemical Sciences*, 14, 319–324.
- Crouch J. H., Vuylsteke D., and Ortiz R. (1998). Perspectives on the application of biotechnology to assist the genetic enhancement of plantain and banana (*Musa spp*). *Electronic Journal of Biotechnology*, 1, <http://www.ejb.org>.
- Crouch J.H. and Crouch H.K. (1999) Application of DNA markers in plantain and banana. In: *DNA Marker-assisted Improvement of the Staple Crops of Sub-Saharan Africa* (Crouch J.H. and Tenkouano A. eds.), IITA Ibadan, Nigeria, pp. 163-167.
- Crouch J.H., Ortiz R., Crouch H.K., Jarret R.L., Ford-Lloyd B.V., Howell E.C. and Newbury H.J. (2000) Utilization of molecular genetic techniques in support of plantain and banana improvement. *Acta Horticulturae*, 540, 185-191.
- Delaney T.P., Uknes S., Vernooij B., Friedrich L., Weymann K., Negrotto D., Gaffney T., Gut-Rella M., Kessmann H., Ward E. and Ryals J. (1994) A central role of salicylic acid in plant disease resistance. *Science*, 266, 1247-1250.
- Delledonne M., Allegro G., Belenghi B., Balestrazzi A., Picco F., Levine A., Zelasco S., Calligari P. and Confalonieri M. (2001) Transformation of white poplar (*Populus alba* L.) with a novel *Arabidopsis thaliana* cysteine proteinase inhibitor and analysis of insect pest resistance. *Molecular Breeding*, 7, 35-42.
- DeVries J. and Toenniessen G. (2001) *Securing the harvest: biotechnology, breeding and seed systems for African crops*. CABI International, New York.



- Ding X., Gopalakrishnan B., Johnson L.B., White F.F., Wang X., Morgan T.D., Kramer K.J. and Muthukrishnan S. (1998). Insect resistance of transgenic tobacco expressing an insect chitinase gene. *Transgenic Research*, 7, 77-84.
- Duan X., Li X., Xue Q., Abo-el-Saad M., Xu D. and Wu R. (1996) Transgenic rice plants harbouring an introduced potato protease inhibitor II gene are insect resistant. *Nature Biotechnology*, 14, 494-498.
- Dunaevskii Y.E. Gladysheva I.P., Pavlukova E.B., Beliakova G.A., Gladyshev D.P., Papisova A.I., Larionova N.I. and Belozersky M.A. (1997) The anionic protease inhibitor BBWI-1 from buckwheat seeds: kinetic properties and possible biological role. *Physiologia Plantarum*, 100, 483-488.
- Dunwell J.M. (1998) Novel food products from genetically modified crop plants: methods and future prospects, *International Journal of Food Science and Technology*, 33, 205-213.
- Edmonds H.S., Gatehouse L.N., Hilder V.A. and Gatehouse J.A. (1996) The inhibitory effects of the cysteine protease inhibitor, oryzacystatin, on digestive proteases and on larval survival and development of the southern corn rootworm (*Diabrotica undecimpunctata howardi*). *Entomologia Experimentalis et Applicata*, 78, 83-94.
- Eguchi M., Iwamoto A. and Yamaguchi K. (1982) Interaction of proteases from the midgut lumen, epithelial and peritrophic membrane of the silkworm *Bombyx mori* L. *Comparative Biochemistry and Physiology-A*, 72, 359-363.
- Epple P., April K. and Bohlmann H. (1995) An *Arabidopsis thaliana* thionin gene is inducible via a signal transduction pathway different from that for pathogenesis related protein. *Plant Physiology*, 109, 813-820.



- Fabrick J., Behnke C., Czapla T., Bala K., Rao A. G., Kramer K.J. and Reeck G.R. (2002) Effects of a potato cysteine proteinase inhibitor on midgut proteolytic enzyme activity and growth of the southern corn rootworm, *Diabrotica undecimpunctata* Howardi (Coleoptera: Chrysomelidae), *Insect Biochemistry and Molecular Biology*, 32, 405-415.
- Farley P.C., Ramsay R.J., Sullivan P.A. and Laing W.A. (1998). Purification, characterization and cloning of an aspartic protease inhibitor from squash phloem exudate. *European Journal of Biochemistry*, 254, 160-167.
- Felsenstein J. (1989) PHYLIP - Phylogeny Inference Package (Version 3.2). *Cladistics*, 5, 164-166.
- Fernandes K.V., Sabelli P.A., Barrat D.H., Richardson M., Xavier-Filho J. and Shewry P.R. (1993) The resistance of cowpea seeds to bruchid beetles is not related to levels of cysteine protease inhibitors. *Plant Molecular Biology*, 23, 215-219.
- Fisher C. L. and Pei G. K. (1997) Modification of a PCR-based site-directed mutagenesis method. *Biotechniques*, 23, 570-574.
- Fogain R., Price, N.S., (1994) Varietal screening of some *Musa* cultivars for susceptibility to the banana weevil, *Cosmopolites sordidus* (Coleoptera: Curculionidae). *Fruits*, 49, 247-251.
- Forgain R., Messiaen S. and Foure E. (2002) Studies on the banana borer weevil in Cameroon. *InfoMusa* 11, 1- 4.
- Frazao C., Isabel B., Julia C., Claudio M.; Verissimo P., Faro C., Pires E. Cooper J. and Carrondo M.A. (1999) Crystal structure of cardosin A, a glycosylated and Arg-Gly-Asp- containing aspartic protease from the flowers of *Cyanara cardunculus* L. *Journal of Biological Chemistry*, 274, 27694-27701.



- Gaddour K., Vicente-Carbajosa J., Lara P., Isabel-Lamoneda I., Diaz I., Carbonero P. (2001) A constitutive cystatin-encoding gene from barley (Icy) responds differentially to abiotic stimuli. *Plant Molecular Biology*, 45, 599-608.
- Garcia-Olmedo S. F., Sanchez M. G., Gomez R.L., Royo J. and Carbonero, P. (1987) Plant proteinaceous inhibitors of proteinases and α -amylases. *Oxford Survey Plant Molecular and Cell Biology*, 4, 275-334.
- Gatehouse A.M.R., Shi Y., Powell K.S., Brough C., Hilder V. A., Hamilton W.D.O., Newell C.A., Merryweather A., Boulter D. and Gatehouse J.A. (1993) Approaches to insect resistance using transgenic plants. *Philosophical Transactions of the Royal Society of London Series B - Biological Sciences*, 342, 279-286.
- Gatehouse A.M.R. and Boulter D. (1993) Assessment of the antimetabolic effects of trypsin inhibitors from cowpea (*Vigna unguiculata*) and other legumes on development of the bruchid beetle *Callosobruchus maculatus*. *Journal of the Science of Food and Agriculture*, 34, 345-350.
- Gatehouse A.M.R., Butler K.J., Fenton K.A. and Gatehouse, J.A., (1985) Presence and partial characterisation of a major proteolytic enzyme in the larval gut of *Callosobruchus maculatus*. *Entomologia Experimentalis et Applicata*, 39, 279-286.
- Gatehouse A.M.R., Davidson G.M., Newell C.A., Merryweather A., Hamilton, W.D.O., Burgess E.P.J., Gilbert R.J.C. and Gatehouse J.A. (1997) Transgenic potato plants with enhanced resistance to the tomato moth, *Lacanobia oleracea*: growth room trials. *Molecular Breeding*, 3, 49-63.
- Gerald R.R., Kramer K.J., Baker J.E., Kanost J.F. and Behke C.A. (1997) Protease inhibitors and resistance of transgenic plants to insects. In: *Advances in*



- Insect Control the Role of Transgenic Plants (Carozi, N. and Koziel, M., eds.), Taylor and Francis, London, pp. 157-183.
- Gholizadeh A., Santha I., Lodha M. and Kapoor H. (2005) Cloning and expression of a small cDNA fragment encoding strong antiviral peptide from *Celosia cristata* in *Escherichia coli*. *Biochemistry*, 70, 1005-1010.
- Girard C., Rivard D., Kiggundu A., Kunert K., Gleddie S.C., Cloutier C. and Michaud D. (2007) A multicomponent, elicitor-inducible cystatin complex in tomato, *Solanum lycopersicum*. *New Phytologist*, 173, 841–851.
- Girard C., Le Métayer M., Bonadé-Bottino M., Pham-Delègue M.H. and Jouanin L. (1998) High level of resistance to protease inhibitors may be conferred by proteolytic cleavage in beetle larvae. *Insect Biochemistry and Molecular Biology*, 28, 229-237.
- Gold C.S., Bagabe M.I. and Sendege R., (1999a). Banana weevil, *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae): tests for suspected resistance to carbofuran and dieldrin in the Masaka District, Uganda. *African Entomology*, 7, 189-196.
- Gold C. S., Karamura E. B., Kiggundu A., Bagamba F. and Abera A. M. K. (1999b). Geographic shifts in highland cooking banana (*Musa* spp. group AAA-EA) production in Uganda. *International Journal of Sustainable Development and World Ecology*, 6, 45-59.
- Gold C. S., Speijer P.R., Karamura E.B. and Rukazambuga D.N. (1994) Assessment of banana weevils in East African highland banana systems and strategies for control. In: *Banana Nematodes and Weevil Borers in Asia and the Pacific* (Valmayor, R.V., Davide, R.G., Stanton, J.M., Treverrow N.L. and Roa V.N.eds.), INIBAP, Los Banoss, Philippines. pp 170-190.



- Gold C.S. (1998) Banana weevil: ecology pest status and prospects for integrated control with emphasis on East Africa. In: Proceedings of a Symposium on Biological Control in Tropical Habitats: Third International Conference on Tropical Entomology (Saini, S.K. ed.), ICIPE, Nairobi, Kenya, pp. 49-74.
- Gold C.S. (2000) Biology and integrated pest management of banana weevil, *Cosmopolites sordidus* (Germar). In: Advancing banana and plantain R&D in Asia and the Pacific (Molina, A.B., Roa, V.N. and Maghuyop, M.A.G. eds.), INIBAP-ASPNET, pp. 28-33.
- Gold C.S. and Messiaen S. (2000) The banana weevil *Cosmopolites sordidus*. *MusaPest INIBAP Fact Sheet No 4*.
- Gold C.S., Peña J.E. and Karamura E.B. (2001) Biology and integrated pest management of the banana weevil, *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae). *Integrated Pest Management Reviews*, 6, 79-155.
- Gonnet G.H., Cohen M.A. and Benner S.A. (1992) Exhaustive matching of the entire protein sequence database. *Science*, 256, 1443-5.
- Gourinath S., Alam N., Srinivasan A., Betzel C. and Singh T.P. (2000) Structure of the bifunctional inhibitor of trypsin and alpha-amylase from ragi seeds at 2.2Å resolution. *Acta Crystallography D Biology Crystallography*, 56, 287-293.
- Graham J., Gordon S.C. and Mcnicol R.J. (1997) The effect of the CpTI gene in strawberry against attack by vine weevil (*Otiorhynchus sulcatus* F. (Coleoptera: Curculionidae). *Annals of Applied Biology*, 131, 133-139.



- Graham J.S. and Ryan, C.A. Accumulation of metallocarboxy-peptidase inhibitor in leaves of wounded potato plants. *Biochemical and Biophysics Research Communication*, 101, 1164-1170.
- Green T.R. and Ryan C.A. (1972) Wound-induced protease inhibitors in plant leaves: a possible defence mechanism against insects. *Science*, 175, 776-777.
- Greenblatt H.M., Ryan C.A. and James M.N.G. (1989) Structure of the complex *Streptomyces griseus* protease B and polypeptide chymotrypsin inhibitor-I at 2.1 Å resolution. *Journal of Molecular Biology*, 205, 201-228.
- Gruden K., Kuipers A.G.J., Guncar G., Slapar N., Strukelj B. and Jongsma M.A. (2004) Molecular basis of Colorado potato beetle adaptation to potato plant defence at the level of digestive cysteine proteinases. *Insect Biochemistry and Molecular Biology*, 34, 365–375.
- Guex N. and Peitsch M. C. (1997) SWISS-MODEL and the Swiss-PdbViewer: An environment for comparative protein modelling. *Electrophoresis*, 18, 2714-2723.
- Habu Y., Peyachoknagul S., Sakata Y., Fukasawa K. and Ohno T. (1997) Evolution of a multigene family that encodes the Kunitz chymotrypsin inhibitor in winged bean: a possible intermediate in the generation of a new gene with a distinct pattern of expression. *Molecular General Genetics*, 254, 73-80.
- Hall T.A. (1999) BioEdit: a user-friendly biological sequence alignment editor and analysis program for Window 95/98/NT. *Nucleic Acids Symposium Series*, 41, 95-98.
- Havkioja E. and Neuvonen L. (1985) Induced long-term resistance to birch foliage against defoliators: defence or incidental. *Ecology*, 66, 1303-1308.



- Heath R.G., McDonald J.T., Christeller M., Lee K., Bateman J., West R., Van Heeswijck and Anderson M.A. (1997) Protease inhibitors from *Nicotiana glauca* enhance plant resistance to insect pests. *Journal of Insect Physiology*, 9, 833-842.
- Hilder V.A., and Boulter D. (1999) Genetic engineering of crop plants for insect resistance: a critical review. *Crop Protection*, 18, 177-191.
- Hilder V.A., Gatehouse A.M.R., Sheerman S.E., Barker R.F. and Boulter D. (1987) A novel mechanism of insects resistance engineered into tobacco. *Nature*, 330, 160-163.
- Hilder V.A., Barker R.F., Samour R.A., Gatehouse A.M.R., Gatehouse J.A. and Boulter D. (1989) Protein and cDNA sequences of Bowman-Birk protease inhibitors from the cowpea (*Vigna unguiculata* Walp.). *Plant Molecular Biology*, 13, 701-710.
- Hildmann T., Ebneith M., Pena-Cortes H., Sanchez-Serrano J.J., Willmitzer L. and Prat S. (1992) General roles of abscisic and jasmonic acids in gene activation as a result of mechanical wounding. *Plant Cell*, 4, 1157-1170.
- Hirashiki I., Ogata F., Yoshida N., Makisumi S., Ito A. (1990) Purification and complex formation analysis of a cysteine protease inhibitor (cystatin) from seeds of *Wisteria floribunda*. *Journal of Biochemistry*, 108, 604-608.
- Hobday S.M., Thurmaen D.A. and Barber D.J. (1973) Proteolytic and trypsin inhibitory activities in extracts of germinating *Pisum sativum* seeds. *Phytochemistry*, 12, 1041-1046.
- Hollander-Czytko H., Andersen J.L. and Ryan C.A. (1985) Vacuolar localization of wound-induced carboxy peptidase inhibitor in potato leaves. *Plant Physiology*, 78, 76-79.

- Houseman J.G. and Downe A.E.R. (1983) Cathepsin D-like activity in the posterior midgut of Hemipteran insects. *Comparative Biochemistry and Physiology-B*, 75, 509-512.
- Houseman J.G., Campbell F.C. and Morrison P.E. (1987) A preliminary characterization of digestive proteases in the posterior midgut of the stable fly *Stomoxys calcitrans* (L.) (Diptera: Muscidae). *Insect Biochemistry*, 17, 213-218.
- Houseman J.G., Downe A.E.R. and Philogene B.J.R. (1987) Partial characterization of protease activity in the larval midgut of the European corn borer *Ostrinia nubilalis* Hubner (Lepidoptera: Pyralidae). *Canadian Journal of Zoology*, 67, 864-868.
- Huang Y.J., To K.Y., Yap M.N., Chiang W.J., Suen D.F. and Chen S.C.G. (2001) Cloning and characterization of leaf senescence up-regulated genes in sweet potato. *Physiologia Plantarum*, 113, 384-391.
- Hubinger G., Gruber P., Vollmann U., Kraft D., Ferreira F. and Himly M. (1999) Molecular cloning and nucleotide sequence analysis of a cDNA (Accession No. AF143677) Encoding the cystatin homolog from Mugwort (*Artemisia vulgaris*) pollen (PGR 99-078). *Plant Physiology*, 120, 634-634.
- Irie K., Hosoyama H., Takeuchi T., Iwabuchi K., Watanabe H., Abe M., Abe K. and Arai S. (1996) Transgenic rice established to express corn cystatin exhibits strong inhibitory activity against insect gut proteases. *Plant Molecular Biology*, 30, 149-157.
- Ishimoto M., Sato T., Chrispeels M.J. and Kitamura K. (1996) Bruchid resistance of transgenic azuki bean expressing seed α -amylase inhibitor of common bean. *Entomologia experimentalis et applicata*, 79, 309-315.



- Ittyeipe K. (1986) Studies on host preference of banana weevil borer, *Cosmopolites sordidus* GERM. (Curculionidae-Coleoptera). *Fruits*, 41, 375-79.
- Jacinto T., Fernandes K.V.S., Machando O.L.T. and Siqyueira-Junior C.L. (1998) Leaves of transgenic tomato plants over expressing prosystemin accumulate high levels of cystatin. *Plant Science*, 138, 35-42.
- Jackson R.M., Gabb H.A. and Sternberg M.J.E. (1998) Rapid refinement of protein interfaces incorporating solvation: application to the docking problem. *Journal of Molecular Biology*, 276, 265–285.
- Jenko S., Dolenc I., Guncar G., Dobersek A., Podobnik M. and Turk D. (2003) Crystal structure of stefin A in complex with cathepsin H: N-terminal residues of inhibitors can adapt to the active sites of endo- and exopeptidases. *Journal of Molecular Biology*, 326, 875-885.
- Johnson R., Narraez J., An G. and Ryan C.A. (1989) Expression of protease inhibitors I and II in transgenic tobacco plants: effects on natural defense against *Manduca sexta* larvae. *Proceedings of the National Academy of Sciences of the United States of America*, 86, 9871-9875.
- Jongsma M.A. and Bolter C. (1997) The adaptation of insects to plant protease inhibitors. *Journal of Insect Physiology*, 43, 885-895.
- Joshi B., Sainani M., Bastawade K., Gupta V.S. and Ranjekar P.K. (1998) Cysteine protease inhibitor from pearl millet: a new class of antifungal protein. *Biochemical and Biophysical Research Communications*, 246, 382-387.
- Jouanin L., Bonade-Bottino M., Girard C., Morrot G. and Giband M. (1998) Transgenic plants for insect resistance. *Plant Science*, 131, 1-11.



- Keilova H. and Tomasek V. (1976) Isolation and properties of cathepsin D inhibitor from potatoes. *Collection of Czechoslovak Chemical Communication*, 41, 489-497.
- Kervinen J., Tobin G.J., Costa J., Waugh D.S., Wlodawer A. and Zdanov A. (1999) Crystal structure of plant aspartic protease prophytepsin: inactivation and vacuolar targeting. *Journal of European Molecular Biology Organization*, 18, 3947-3955.
- Kiggundu A., Gold C.S, Labuschagne M., Vuylsteke H.K. and Louw S.V.D.M. (2003a) Levels of host plant resistance to banana weevil *Cosmopolites sordidus* (Germar) (Coleoptera: Curculionidae) in African *Musa* germplasm. *Euphytica*, 133, 267-277.
- Kiggundu A., Pillay M., Viljoen A., Gold C., Tushemereirwe W. and Kunert K. (2003b) Enhancing banana weevil (*Cosmopolites sordidus*) by genetic modification. A perspective. *African Journal of Biotechnology*, 2, 563-569.
- Kiggundu A., Vuylsteke D. and Gold C. (1999) Recent advances in host plant resistance to banana weevil, *Cosmopolites sordidus* (Germar) In: *Mobilizing IPM for sustainable banana production in Africa Proceedings of a workshop on banana IPM* (Frison, E. A., Gold, C.S., Karamura, E. B. and Sikora, R. A., eds), INIBAP, Montpellier, France, pp. 87-96.
- Kimura M., Ikeda T., Fukumoto D., Yamasaki N. and Yonekura M. (1995) Primary structure of a cysteine protease inhibitor from the fruit of avocado (*Persea americana* Mill) *Bioscience Biotechnology and Biochemistry*, 59, 2328-2329.
- Kishimoto N., Higo H., Abe K., Arai S., Saito A. and Higo K. (1994) Identification of the duplicated segments in rice chromosomes 1 and 5 by linkage analysis of



cDNA markers of known functions. *Theoretical and Applied Genetics*, 88, 722-726.

Kitch L.W. and Murdock L.L. (1986) Partial characterization of a major gut thiol protease from larvae of *Callosobruchus maculatus* (F.). *Archives of Insect Biochemistry and Physiology*, 3, 561-575.

Koiwa H., Bressan R.A. and Hasegawa P.M. (1997) Regulation of protease inhibitors and plant defense. *Trends in Plant Science*, 2, 379-384.

Koiwa H., Shade R.E, Zhu-Salzman K., D'Urzo M.P., Murdock L.L., Bressan R.A. and Hasegawa P.M. (2000) A plant defensive cystatin (soyacystatin) targets cathepsin L-like digestive cysteine proteinases (DvCALs) in the larval midgut of western corn rootworm (*Diabrotica virgifera virgifera*). *FEBS Letters*, 471, 67-70.

Koiwa K., Shade R.E., Zhu-Salzman K., Subramanian L., Murdock L.L., Nielsen S.S., Bressan R.A. and Hasegawa P.M. (1998) Phage display selection can differentiate insecticidal activity of soybean cystatins. *Plant Journal*, 14, 371-379.

Kondo H., Abe K., Nishimura I., Watanabe H., Emori Y. and Arai S. (1990) Two distinct cystatin species in rice seeds with different specificities against cysteine proteinases. Molecular cloning, expression, and biochemical studies on oryzacystatin-II. *Journal of Biological Chemistry*, 265, 15832-15837.

Kondo H., Abe K., Emori Y. and Arai S. (1991) Gene organization of oryzacystatin-II, a new cystatin superfamily member of plant origin, is closely related to that of oryzacystatin-I but different from those of animal cystatins. *FEBS Letters*, 278, 87-90.



- Koradi R., Billeter M., Wüthrich K. 1996. MOLMOL: A program for display and analysis of macromolecular structures, *Journal of Molecular Graphics*, 14, 51-55.
- Kouzuma Y., Kawano K., Kimura M., Yamasaki N., Kadowaki T. and Yamamoto K. (1996) Purification, characterization, and sequencing of two cysteine protease inhibitors, Sca and Scb, from sunflower (*Helianthus annuus*) seeds *Journal of Biochemistry*, 119, 1106-1113.
- Kouzuma Y., Inanaga H., Doi-Kawano K., Yamasaki N. and Kimura M. (2000) Molecular cloning and functional expression of a cDNA encoding the cysteine protease inhibitor with three cystatin domains from sunflower seeds *Journal of Biochemistry*, 128, 161-166.
- Krattiger A.F. (1997) Insect resistance in crops: a case study of *Bacillus thuringiensis* (Bt) and its transfer to developing countries. International Service for the Acquisition of Agri-biotech Applications (ISAAA) Briefs, Ithaca, USA 2: p.42.
- Kunitz M. (1994) Crystallization of a trypsin inhibitor from soybean. *Science*, 101, 668-669.
- Kuroda M., Kiyosaki T., Matsumoto I., Misaka T., Arai S. and Abe K (2001) Molecular cloning, characterization, and expression of wheat cystatins. *Bioscience Biotechnology and Biochemistry*, 65, 22-28.
- Laboissiere M.C.A., Young M.M., Pinho R.G., Todd S., Fletterick R.J., Kuntz I. and Craik C.S. (2002) Computer-assisted mutagenesis of ecotin to engineer its secondary binding site for urokinase inhibition. *Journal of Biological Chemistry*, 277, 26623–26631.



- Laskowski R.A., MacArthur M.W., Moss D.S. and Thornton J.M. (1993) PROCHECK: a program to check the stereochemical quality of protein structures. *Journal of Applied Crystallography*, 26, 283-291.
- Laskowski M. Jr. and Kato, I. (1980) Protein inhibitors of proteinases. *Annual Review of Biochemistry*, 49, 685-693.
- Lawrence P.K. and Koundal K.R. (2002) Plant protease inhibitors in control of phytophagous insects. *Electronic Journal of Biotechnology*, 5, 93-109.
- Lawrence P. K., Nirmala J. and Koundal K.R. (2001) Nucleotide sequence of a genomic clone encoding a cowpea (*Vigna unguiculata* L.) trypsin inhibitor. *Electronic Journal of Biotechnology*, 4, 1 <http://www.ejbiotechnology.info/content/vol4/issue1/full/4/index.html>. ISSN 0717-3458.
- LeBerre-Anton, V., Bompard-Gilles C., Payan F., Rouge P. (1997) Characterization and functional properties of the alpha-amylase inhibitor (alpha A-1) from kidney bean (*Phaseolus vulgaris*) seeds. *Biochemica et Biophysica Acta*, 1343, 31-40.
- Lecardonnell A., Chauvin L., Jouanin L.O., Beaujean A., Prevost G. and Sangwan-Novrreel B. (1999) Effect of rice cystatin I expression in transgenic potato on Colorado potato beetle larvae. *Plant Science*, 140, 71-79.
- Lemos F.J.A., Xavier-Filho J. and Campos F.A.P. (1987) Proteinases of the midgut of *Savrotes subfasciatus* larvae. *Agricultural Biology and Technology*, 80, 46-49.
- Lepie J.C., Bonade M., Bontt S., Augustin G., Pilate V., Dumanoise L. R, Delplanque A., Cornu D. and Jouanin L. (1995) Toxicity to *Chrysomela tremulae* (Coleoptera: chrysomelidae) of transgenic polars expressing a cysteine inhibitor. *Molecular Breeding*, 1: 319-328.



- Lheureux F., Carreel F., Jenny C. Lockhart B.E.L. and Iskra-Caruana M.L. (2003) Identification of genetic markers linked to banana streak disease expression in inter-specific *Musa* hybrids. *Theoretical and Applied Genetics*, 106, 594-598.
- Li Z., Sommer A., Dingermann T. and Noe C.R. (1996) Molecular cloning and sequence analysis of a cDNA encoding a cysteine protease inhibitor of *Sorghum bicolor* seedlings. *Molecular and General Genetics*, 251, 499-502.
- Li, Y.E., Zhu Z., Chen Z.X., Wu X., Wang W. and Li S.J. (1998) Obtaining transgenic cotton plants with cowpea trypsin inhibitor. *Acta Gossypii Sinica*, 998, 237-243.
- Liang C., Brookhart G., Feng G.H., Reeck G.R. and Kramer K.J. (1991) Inhibition of digestive proteases of stored grain Coleoptera by oryzacystatin, a cysteine protease inhibitor from rice seed. *FEBS Letters*, 278, 139-142.
- Lim C.O., Lee S.I., Chung W.S., Park S.H., Hwang I., Cho M.J. (1996) Characterization of a cDNA encoding cysteine protease inhibitor from Chinese cabbage (*Brassica campestris* L. ssp. *pekinensis*) flower buds. *Plant Molecular Biology*, 30, 373-379.
- Lipke H., Fraenkel G.S. and Liener I.E. (1954) Effects of soybean inhibitors on growth of *Tribolium confusum*. *Journal of the Science of Food and Agriculture*, 2, 410-415.
- Lopes A.R., Juliano M.A., Juliano L. and Terra W.R. (2004) Coevolution of insect trypsins and inhibitors. *Archives of Insect Biochemistry and Physiology*, 55, 140–152.
- MacPhalen C.N. and James M.N.G. (1987) Crystal and molecular structure of the serine protease inhibitor CI-2 from barley seeds. *Biochemistry*, 26, 261-269.



- Malone M. and Alarcon J.J. (1995) Only xylem-borne factors can account for systemic wound signalling in the tomato plant. *Planta*, 196, 740-746.
- Margis R., Reis E.M. and Villeret V. (1998) Structural and phylogenetic relationships among plant and animal cystatins. *Archives of Biochemistry and Biophysics*, 359, 24-30.
- Mark S.J. and Overington J.P. (1993) A Structural Basis for Sequence Comparisons: An Evaluation of Scoring Methodologies *Journal of Molecular Biology*, 233, 716-738.
- Mason R.W., Sol-Church K. and Abrahamson M. (1998) Amino acid substitutions in the N-terminal segment of cystatin C create selective protein inhibitors of lysosomal cysteine proteinases. *Biochemistry Journal*, 330, 833–838.
- Mazumdar-Leighton S. and Broadway R.M. (2001) Identification of six chymotrypsin cDNAs from larval midguts of *Helicoverpa zea* and *Agrotis ipsilon* feeding on the soybean (Kunitz) trypsin inhibitor. *Insect Biochemistry and Molecular Biology*, 31, 633–644.
- McGurl B., Orozco-Cardenas M., Pearce G. and Ryan C.A. (1994) Over expression of the prosystemin gene in transgenic tomato plants generates a systemic signal that constitutively induces protease inhibitor synthesis. *Proceedings of the National Academy of Sciences of the United States of America*, 91, 9799-9802.
- McManus M.T., White W.R. and McGregor P.G. (1994) Accumulation of a chymotrypsin inhibitor in transgenic tobacco can affect the growth of insect pests. *Transgenic Research*, 3, 50-58.



- Mello M.O., Tanaka A.S. and Silva-Filho M.C. (2003) Molecular evolution of Bowman–Birk type proteinase inhibitors in flowering plants. *Molecular Phylogenetics and Evolution*, 27, 103–112.
- Melville J.C. and Ryan C.A. (1973) Chymotrypsin inhibitor I from potato: large scale preparation and the characterization of its subunit components. *Journal of Biological Chemistry*, 247, 3415-3453.
- Mesquita A.L.M., Alvers E.J. and Caldas R.C. (1984) Resistance of banana cultivars to *Cosmopolites sordidus* (GERMAR, 1824). *Fruits*, 39, 254-257.
- Michaud, D. and Vrain T.C. (1998) Expression of recombinant protease inhibitors in plants. In: *Recombinant proteins from plants: Production and isolation of clinically useful compounds* (Cunningham, C. and Porter, A.J.R. (eds.), Humana Press Inc., Totowa, NJ, pp. 49-64.
- Michaud D. (1997) Avoiding protease mediated resistance in herbivorous pests. *Trends in Biotechnology*, 15, 4-6.
- Michaud D., Nguyen-Quoc B. and Yelle S. (1993) Selective inactivation of Colorado potato beetle cathepsin H by oryzacystatin I and II. *FEBS Letters*, 331, 173-176.
- Michaud D., Bernier-Vandnais N., Overney S. and Yelle S. (1995) Constitutive expression of digestive cysteine protease forms during development of the Colorado potato beetle, *Leptinotarsa decemlineata* Say (Coleoptera: Chrysomelidae). *Insect Biochemistry and Molecular Biology*, 25, 1041-1048.
- Michaud D., Nguyen-Quoc B. and Yelle S. (1993) Selective inactivation of Colorado potato beetle cathepsin H by oryzacystatin I and II. *FEBS Letters*, 331, 173-176.



- Michaud D., Nguyen-Quoc B. and Yelle S. (1994) Production of oryzacystatins I and II in *Escherichia coli* using the glutathione *S*-transferase gene fusion system. *Biotechnology Progress*, 10, 155-159.
- Michaud D. (1998) Gel electrophoresis of proteolytic enzymes. *Analytica Chimica Acta*, 372, 173-185.
- Michaud D., Cantin L. and Vrain T.C. (1995) Carboxy terminal truncation of oryzacystatin II by oryzacystatin insensitive insect digestive proteinases. *Archives of Biochemistry and Biophysics*, 322, 469-474.
- Michaud D., Nguyen-Quoc B., Vrain T.C., Fong D. and Yelle S. (1996) Response of digestive cysteine proteinases from the Colorado potato beetle (*Leptinotarsa decemlineata*) and the black vine weevil (*Otiorynchus sulcatus*) to a recombinant form of human stefin A. *Archives of Insect Biochemistry and Physiology*, 31, 451-64.
- Mickel C.E. and Standish J. (1947) Susceptibility of processed soy flour and soy grits in storage to attack by *Tribolium castaneum*. University of Minnesota Agricultural Experimental Station Technical Bulletin, 178, 1-20.
- Mochizuki A. (1998) Characteristics of digestive proteases in the gut of some insect orders. *Applied Entomology and Zoology*, 33, 401-407.
- Moon, J., Salzman R.A., Ahn J. E., Koiwa H. and Zhu-Salzman K. (2004) Transcriptional regulation in cowpea bruchid guts during adaptation to a plant defence protease inhibitor. *Insect Molecular Biology*, 13, 283–291.
- Morton R.L., Schoroeder H.E., Bateman K.S., Chrispeels M.J., Armstrong E. and Higgins T.J.V. (2000) Bean α -amylase inhibitor-I in transgenic peas (*Pisium sativum*) provided complete protection from pea weevil (*Bruchus pisorum*)



under field conditions. Proceedings of the National Academy of Science of the United States of America, 97, 3820-3825.

Mukhopadhyay D. (2000) The molecular evolutionary history of an winged bean alpha-chymotrypsin inhibitor and modeling of its mutations through structural analysis. Journal of Molecular Evolution, 50, 214-223.

Murdock L.L., Brookhart G., Dunn P.E., Foard D.E., Kelley S., Kitch L., Shade R.E., Shuckle R.H. and Wolfson J.L. (1987). Cysteine digestive proteinases in Choleptera. Comparative Biochemistry and Physiology, 87, 783-787.

Murdock L.L., Shade R.E., Pomeroy M.A. (1988) Effects of E-64, a cysteine protease inhibitor on cowpea weevil growth, development, and fecundity. Environmental Entomology, 17, 467-469.

Musabyimana T., Seshu Reddy K.V. and Ngode L. (2000) Evaluation of banana cultivars for resistance to the banana weevil *Cosmopolites Sordidus* and nematode complex in western Kenya. Acta Horticulturae, 540, 233-238.

Nagata K., Kudo N., Abe K., Arai S. and Tanokura M. (2000) Three-dimensional solution structure of Oryzacystatin-I, a cysteine protease inhibitor of the Rice, *Oryza sativa* L. japonica. Biochemistry, 39, 14753-14760.

Newell C., Lowe J. and Merryweather A. (1995) Transformation of sweetpotato (*Ipomoea batatas* (L.) Lam.) with *Agrobacterium tumefaciens* and regeneration of plants expressing cowpea trypsin inhibitor and snowdrop lectin. Plant Science, 107, 215-227.

Nikawa T., Towatari T., Ike Y. and Katunuma N. (1989) Studies on the reactive site of the cystatin superfamily using recombinant cystatin A mutants. Evidence that the QVVAG region is not essential for cysteine proteinase inhibitory activities. FEBS Letters, 255, 309-314.



- Odani S., Koide T. and Ono T. (1983) The complete amino acid sequence of barley trypsin inhibitor. *Journal of Biological Chemistry*, 258, 7998-8003.
- Ogawa M., Nakamura S., Scaman C.H., Jing H., Kitts D.D., Dou J. and Nakai S. (2002) Enhancement of proteinase inhibitory activity of recombinant human cystatin C using random-centroid optimization. *Biochimica et Biophysica Acta* 1599, 115–124.
- Ojima A., Shiota H., Higashi K., Kamada H., Shimma Y., Wada M. and Satoh S. (1997) An extracellular insoluble inhibitor of cysteine proteinases in cell cultures and seeds of carrot. *Plant Molecular Biology*, 34, 99-109.
- Oliveira A.S., Xavier-Filho J. and Sales M.P. (2003) Cysteine Proteinases and cystatins. *Brazilian Archives of Biology and Technology*, 46, 91-104.
- Orr G.L., Strickland J.A. and Walsh T.A. (1994) Inhibition of *Diabrotica* larval growth by a multicystatin from potato tubers. *Journal of Insect Physiology*, 40, 893-900.
- Ortiz R., Vuylsteke D., Dumpe B. and Ferris R.S.B. (1995) Banana weevil resistance and corm hardness in *Musa* germplasm. *Euphytica*, 86, 95-102.
- Ortiz R. (2000) Understanding the *Musa* genome: an update. *Acta Horticulturae*, 540, 157-168.
- Ostmark H.E. (1974) Economic insect pests of bananas *Annual Reviews of Entomology*, 19, 161-176.
- Padmanaban B., Sundararaju P., Velayudhan K.C. and Sathiamoorthy S. (2001) Evaluation of *Musa* germplasm against banana weevil borers *Infomusa* 10, 26-28.
- Page R.D.M. (1996) TREEVIEW: An application to display phylogenetic trees on personal computers. *Computer Applications in the Biosciences*, 12, 357-358.



- Painter R.H. (1951) Insect resistance in crop plants. The Macmillan Co., New York. 520.
- Pannetier C., Giband M., Couzi P., Letan V., Mazier M., Tourneur J. and Hau B. (1997) Introduction of new traits into cotton through genetic engineering: insect resistance as an example. *Euphytica*, 96, 163-166.
- Park H., Yamanaka N., Mikkonen A., Kusakabe I. and Kobayashi H. (2000) Purification and characterization of aspartic protease from sunflower seeds. *Bioscience Biotechnology and Biochemistry*, 64, 931-939.
- Pavis C. and Lemaire L. (1997) Resistance of *Musa* germplasm to the banana borer weevil, *Cosmopolites sordidus* Germar (Coleoptera: Curculionidae) *InfoMusa*, 5, 3-9.
- Pavis C. and Minost C. (1993) Banana resistance to the banana weevil borer *Cosmopolites sordidus* Germar (Coleoptera: Curculionidae); role of pseudostem attractivity and physical properties of the rhizome. In: Proceedings of international symposium on genetic improvement of banana for resistance to diseases and pests, CIRAD-FLHOR, Montpellier France, pp. 129-142.
- Pavlova A. and Bjork I. (2003) Grafting of features of cystatins C or B into the N-terminal region or second binding loop of cystatin A (stefin A) substantially enhances inhibition of cysteine proteinases. *Biochemistry*, 42, 11326–11333.
- Perler F., Efstratiadis A., Lomedico P., Gilbert N., Kolodner R. and Oodgson J. (1980) The evolution of genes: the chicken preproinsulin gene. *Cell*, 20, 555-556.



- Pernas M., Sanchez-Monge R., Gomez L. and Salcedo G. (1998) A chestnut seed cystatin differentially effective against cysteine proteinases from closely related pests. *Plant Molecular Biology*, 38, 1235-1242.
- Pernas M., Sanchez-Mong R. and Salcedo G. (2000) Biotic and abiotic stress can induce cystatin expression in chestnut. *FEBS Letters*, 467, 206-210.
- Pillay M., Ogundiwin E., Nwakanma D.C., Ude G. and Tenkouano A. (2001) Analysis of genetic diversity and relationships in East African banana germplasm. *Theoretical and Applied Genetics*, 102, 965-970.
- Powell W., Morgante M., Andre C., Hanafey M., Vogel J., Tingey S. and Rafalski A. (1996) The comparison of RFLP, RAPD, AFLP, and SSR microsatellite markers for germplasm analysis. *Molecular Breeding*, 2, 225-238.
- Price N.S. (1994) Alternate cropping in the management of *Rodopholus similes* and *Cosmopolites sordidus*, two important pests of banana and plantain. *International Journal for pest Management*, 40, 237-244.
- Rancour J.M. and Ryan C. A. (1968) Isolation of a carboxypeptidase B inhibitor from potatoes. *Archives of Biochemistry and Biophysics*, 125, 380-382.
- Rassam M. and Laing W.A. (2004) Purification and characterization of phytocystatins from kiwifruit cortex and seeds. *Phytochemistry*, 65, 19-30.
- Ravichandaran S., Sen U., Chakrabarti C. and Dattagupta J.K. (1999) Cryocrystallography of a Kunitz type serine protease inhibitor: 90K structure of winged bean chymotrypsin (WCI) at 2.13Å resolution. *Acta Crystallography D Biology Crystallography*, 55, 1814-1821.
- Rawlings N.D. and Barrett A.J. (1995) Evolutionary families of metalloproteinases. In: *Methods in Enzymology* (Barrett A.J. (ed.). New York, Academic Press, 248, 183-228.



- Reis E.M. and Margis R. (2001) Sugarcane phytocystatins: Identification, classification and expression pattern analysis. *Genetics and Molecular Biology*, 24, 291-296.
- Richardson M.J. (1991) Seed storage proteins: The enzyme inhibitors. In: *Methods in Plant Biochemistry* (Richardson, M.J ed.), New York, Academic Press, 259-305.
- Rogel B., Tatjana P., Ritonja A., Strukelj J. and Brzin J. (1998) Chelidocystatin, A novel phytocystatin from *Chelidonium majus*. *Phytochemistry*, 49, 1645-1649.
- Rogers B.L., Pollock J., Klapper D.G. and Griffith I.J. (1993) Sequence of the protease-inhibitor cystatin homologue from the pollen of *Ambrosia artemisiifolia* (short ragweed). *Gene*, 133, 219-221.
- Rukazambuga N.D.T.M., Gold C.S. and Gowen S. (1998) Yield loss in East African highland banana (*Musa* spp., AAA-EA group) caused by the banana weevil, *Cosmopolites sordidus* Germar. *Crop Protection*, 17, 581-589.
- Ryan C.A. (1990) Protease inhibitors in plants: genes for improving resistance against insects and pathogens. *Annual Review of Phytopathology*, 28, 425-449.
- Ryan S.N., Laing W. A. and McManus M. (1998) A cysteine protease inhibitor from apple fruit. *Phytochemistry*, 49, 957-963.
- Ryan C.A. (1989) Insect-induced chemical signals regulating natural plant protection responses. In: *Variable plants and herbivores in natural and managed systems*. Denno, R.F. and McClure M.S. (eds.). New York, Academic Press, p. 43-60.
- Ryan C.A. (2000) The systemin signalling pathway: differential activation of plant defensive genes. *Biochimica et Biophysica Acta*, 1477, 112-121.



- Salvesen G. and Nagase H. (1989) Inhibition of proteolytic enzymes. In: Proteolytic enzymes. A practical approach, IRL Press, New York, pp 83-104.
- Sambrook J., Fritsh E.F. and Maniatis T. (1989) Molecular cloning: A laboratory Manual, 2nd ed. Cold Spring Harbor Laboratory, Cold Springs Houbour, NY.
- Sánchez R. and Sali A. (2000) Comparative protein structure modelling: Introduction and practical examples with MODELLER. In: Protein Structure Prediction: Methods and Protocols (Webster, D.M. ed.). Humana Press. pp. 97-129.
- Sane V.A., Nath P., Aminuddin L. and Sane P.V. (1997) Development of insect-resistant transgenic plants using plant genes: expression of cowpea trypsin inhibitor in transgenic tobacco plants. *Current Science*, 72, 741-747.
- Santino A., Gallo A., Leone A., Poltronieri P. and Zacheo G. (1998) Purification and characterization of a novel papain inhibitor from common bean (*Phaseolus vulgaris*) seed. *Physiologia Plantarum*, 104, 293-298.
- Sarath G. (1989) Protease assay methods. In: Proteolytic enzymes: a practical approach (Beynon, R. J. and Bond J. S. (rend eds.). Oxford: IRL Press.
- Sardana R.K., Ganz P.R., Dudani A.K., Tackaberry E.S., Cheng X. and Altosaar I. (1998) Synthesis of recombinant human cytokine GMCSF in the seeds of transgenic tobacco plants. In: Recombinant proteins from plants. Production and isolation of clinically useful compounds (Cunningham, C. and Porter A.J.R., eds). Totowa NJ, Humana Press, p. 77-87.
- Sawyer S.L., Wu L.I., Emerman M. and Malik H.S. (2005) Positive selection of primate TRIM5a identifies a critical species-specific retroviral restriction domain. *Proceedings of the National academy of Sciences of the United States of America*, 102, 2832–2837.



- Scribner K.T. and Pearce J.M. (2000) Microsatellites: evolutionary and methodological background and empirical applications at individual, population, and phylogenetic levels. In: *Molecular Methods in Ecology* (Baker, ed). Blackwell Science Limited, London, pp. 235-271.
- Sengooba T. (1986) Survey of banana pest problem complex in Rakai and Masaka Districts in Uganda. August 1986: Preliminary trip report, Namulonge Research Station, Namulonge, Uganda.
- Seshu-Reddy K.V. and Lubega M.C. (1993) Evaluation of banana cultivars for resistance to tolerance of the weevil *Cosmopolites sordidus* Germar, In: *Breeding Banana and Plantain for Resistance to Diseases and Pests* (Ganry, J. ed). CIRAD/INIBAP, Montpellier, France, pp. 143-148.
- Shulke R.H. and Murdock L.L. (1983) Lipoxigenase trypsin inhibitor and lectin from soybeans: effects on larval growth of *Manduca sexta* (Lepidoptera: Sphingidae). *Environmental Entomology*, 12, 787-791.
- Soares-Costa A., Beltramini L.M., Thiemann O.H. and Henrique-Silva F. (2002) A sugarcane cystatin: recombinant expression, purification, and antifungal activity. *Biochemical and Biophysical Research Communications*, 296, 1194-1199.
- Solomon M., Belenghi B., Delledonne M., Menachem E. and Levine M. (1999) The involvement of cysteine proteases and protease inhibitor genes in the regulation of programmed cell death in plants. *The Plant Cell*, 11, 431-443.
- Song I., Taylor M., Baker K. and Bateman R.C. (1995) Inhibition of cysteine proteinases by *Carica papaya* cystatin produced in *Escherichia coli*. *Gene*, 162, 221-224.



- Stoop A.A. and Craik C.S. (2003) Engineering of a macromolecular scaffold to develop specific protease inhibitors. *Nature Biotechnology*, 21, 1063–1068.
- Stubbs M.T., Laber B., Bode W., Huber R., Jerala R., Lenarcic B. and Turk V. (1990) The refined 2.4Å x-ray crystal structure of recombinant human stefin B in complex with the cysteine proteinase papain: a novel type of proteinase inhibitor interaction. *EMBO Journal*, 9, 1939–1947.
- Swennen R. and Vuylsteke D. (2001) Banana *Musa L.* In: *Crop Production in Tropical Africa* (Raemaekers, R.H. ed.). DGIC Brussels, Belgium, pp.530-552.
- Thomas J.C., Adams D.G., Keppenne V.D., Wasmann C.C., Brown J.K., Kanosh M.R. and Bohnert H.J. (1995) Proteinase inhibitors of *Manduca sexta* expressed in transgenic cotton. *Plant Cell Reports*, 14, 758-762.
- Tiffin P. and Brandon G.S. (2001) Molecular evolution of the wound- induced serine protease inhibitor wip1 In *Zea* and related genera. *Molecular Biology and Evolution*, 18, 2092-20101.
- Tinjuangjun P. (2002) Snowdrop lectin gene in transgenic plants: its potential for Asian agriculture. www.agbiotechnet.com (ABN091).
- Titarenko E., Rojo E., Leon J. and Sanchez-Serrano J.J. (1997) Jasmonic acid-dependent and -independent signalling pathways control wound-induced gene activation in *Arabidopsis thaliana*. *Plant Physiology*, 115, 817-826.
- To K.Y., Suen D.F. and Chen S.C.G. (1999) A sweet potato leaf cDNA (Accession No. AF117334) encoding cysteine proteinase inhibitor. (PGR99-056). *Plant Physiology*, 119, 1568-1568.



- Tripathi L. (2003) Genetic engineering for improvement of *Musa* production in Africa. *African Journal of Biotechnology*, 2, 503-508.
- Turk V. and Bode W. (1991) The cystatins: protein inhibitors of cysteine proteinases. *FEBS Letters*, 285, 213-219.
- Urwin P.E., Atkinson H.J., Waller D.A. and Mcpherson M.J. (1995) Engineered oryzacystatin-I expressed in hairy roots confers resistance to *Globodera pallida*. *Plant Journal*, 8, 121-131.
- Urwin P.E., Lilley C.J., Mcpherson M.J. and Atkinson H.J. (1997) Resistance to both cyst and rootknot nematodes conferred by transgenic *Arabidopsis* expressing a modified plant cystatin. *Plant Journal*, 12, 455-461.
- Ussuf K.K., Laxmi N.H. and Mitra R. (2001) Proteinase inhibitors: Plant-derived genes of insecticidal protein for developing insect-resistant transgenic plants. *Current Science*, 80, 847- 552.
- Vain P., Worland B., Clarke M.C., Richard G., Beavis M., Liu H., Kohli A., Leech M., Snape J. and Christou P. (1998) Expression of an engineered cysteine proteinase inhibitor (Oryzacystatin-I delta 86) for nematode resistance in transgenic rice plants. *Theoretical and Applied Genetics*, 96, 266-271.
- Van der Vyver C., Schneidereit J., Driscoll S., Turner J., Kunert K.J. and Foyer C.H. (2003) Oryzacystatin-I expression in transformed tobacco produces a conditional growth phenotype and enhances cold tolerance. *Plant Biotechnology Journal*, 1, 101-112.
- Viljoen A., Kunert K., Kiggundu A. and Escalant J.V. (2004) Biotechnology for sustainable banana and plantain production in Africa: the South African Contribution. *South African Journal of Botany*, 70, 67-74.



- Visser A. A. (2000) Characterization of banana and plantain using random amplified polymorphic DNA markers. *Acta Horticulturae*, 540, 113-123.
- Vuylsteke D., Ortiz R., Ferris S. and Crouch J. (1997) Plantain improvement. *Plant Breeding Reviews*, 14, 267-320.
- Waldron C., Wegrich L.M., Merlo P.A. and Walsh T.A. (1993) Characterization of a genomic sequence coding for potato multicystatin, an eight-domain cysteine proteinase inhibitor *Plant Molecular Biology*, 23, 801-812.
- Walsh T.A. and Strickland J.A. (1993) Proteolysis of the 85-kilodalton crystalline cysteine proteinase inhibitor from potato releases functional cystatin domains. *Plant Physiology*, 103, 1227-1234.
- Wang W. and Malcolm B.A. (1999) Two-stage PCR protocol allowing introduction of multiple mutations, deletions and insertions using QuickChange Site-Directed Mutagenesis. *Biotechniques*, 26, 680-682.
- Wasternack C. and Parthier B. (1997) Jasmonate-signalled plant gene expression. *Trends in Plant Science*, 2, 302-307.
- Wieman K.F. and Nielsen S.S. (1988) Isolation and partial characterization of a major gut proteinase from larval *Acanthoscelides obtectus* Say (Coleoptera: bruchidae). *Comparative Biochemistry and Physiology-B*, 89, 419-426.
- Wilhite S.E., Elden T.C., Brzin J. and Smigocki A.C. (2000) Inhibition of cysteine and aspartyl proteinases in the alfalfa weevil midgut with biochemical and plant derived proteinase inhibitors. *Insect Biochemistry and Molecular Biology*, 30, 1181-1188.
- Williamson V.M. and Hussey R.S. (1996) Nematode pathogenesis and resistance in plants. *Plant Cell*, 8, 1735-1745.



- Winterer J. (2002) The mixed success of proteinase inhibitors to combat insect pests in transgenic crops. *www.AgBiotech.Net*, 4, 1-7.
- Wolfson J.L. and Murdock L.L. (1990) Diversity in digestive proteinase activity among insects. *Journal of Chemical Ecology*, 16, 1089-1102.
- Wolfson J.L. and Murdock L.L. (1987) Suppression of larval Colorado beetle growth and development by digestive proteinase inhibitors. *Entomologia Experimentalis et Applicata*, 44, 235-240.
- Xu D.P., Xue, Q.Z., Mcelroy D., Mawal Y., Hilder V.A. and Wu R. (1996) Constitutive expression of a cowpea trypsin inhibitor gene, CpTi, in transgenic rice plants confers resistance to two major rice insect pests. *Molecular Breeding*, 2, 167-173.
- Yang Z. (1997) PAML: a program package for phylogenetic analysis by maximum likelihood. *Computer applications in the biosciences*, 13, 555–556.
- Yang Z. and Bielawski J.P. (2000) Statistical methods for detecting molecular adaptation. *Trends in Ecology & Evolution*, 15, 496–503.
- Yang Z., Nielsen R., Goldman N. and Pedersen A.M.K. (2000) Codon-substitution models for heterogeneous selection pressure at amino acid sites. *Genetics*, 155, 431–449.
- Yeh K.W., Lin M.L., Tuan S.J., Chen Y.M., Lin C.Y. and Kao S.S. (1997) Sweet potato (*Ipomea batatas*) trypsin inhibitors expressed in transgenic tobacco plants confer resistance against *Spodoptera litura*. *Plant Cell Reporter*, 16, 696-699.
- Young, L. and Dong Q. (2003) TAMS technology for simple and efficient in vitro site-directed mutagenesis and mutant screening. *Nucleic Acids Research*, 31, 11-13.



Zhao, Y., Botella M.A., Subramanian L., Niu X., Nielsen S.S., Bressan R.A. and

Hasegawa P.M. (1996) Two wound-inducible soybean cysteine proteinase inhibitors have greater insect digestive proteinase inhibitory activities than a constitutive homologue. *Plant Physiology*, 111, 1299-1306.

Zhu-Salzman, K., Salzman R.A., Koiwa H., Murdock L.L., Bressan R.A. and

Hasegawa P.M. (1998) Ethylene negatively regulates local expression of plant defense lectin genes. *Physiologia Plantarum*, 104, 365-372.