UNIVERSITI PUTRA MALAYSIA

BACTERIA-BASED BIOPESTICIDES PRODUCTION USING SHRIMP POND SLUDGE AS POTENTIAL CHEAP CULTURE MEDIA AND ENTOMOTOXICITY ACTIVITY AGAINST FRUIT FLIES (Bactrocera dorsalis HENDEL)

NOORMASSHELA ULUL AZMI

FS 2015 83

BACTERIA-BASED BIOPESTICIDES PRODUCTION USING SHRIMP POND SLUDGE AS POTENTIAL CHEAP CULTURE MEDIA AND ENTOMOTOXICITY ACTIVITY AGAINST FRUIT FLIES (*Bactrocera dorsalis* HENDEL)

By

NOORMASSHELA BINTI ULUL AZMI

Thesis Submitted to the School of Graduate Studies, Universiti Putra Malaysia, in Fulfilment of the Requirements for the Degree of Master of Science

April 2015

Abstract of thesis presented to the Senate of Universiti Putra Malaysia in fulfilment of the requirement for the degree of Master of Science

BACTERIA-BASED BIOPESTICIDES PRODUCTION USING SHRIMP POND SLUDGE AS POTENTIAL CHEAP CULTURE MEDIA AND ENTOMOTOXICITY ACTIVITY AGAINST FRUIT FLIES (*Bactrocera dorsalis* HENDEL)

By

NOORMASSHELA BINTI ULUL AZMI

April 2015

Chair: Muskhazli Mustafa, PhD

Faculty: Science

Biological controls of destructive pest in forest and agriculture sector using bacteria were proven to minimize the problems caused by the usage of chemical pesticides. However, their application is limited due to high production cost through fermentation. It is therefore necessary to develop potential alternatives culture media for a bacteria-based biopesticides production. In this study, shrimp pond sludge and wastewater were used as an alternate culture media for bacteria-based biopesticides production. The alternate media were prepared under three different preparations; without pre-treatment (unhydrolysed), with acid treatment (hydrolysed) and the supernatant obtained after the centrifugation of the hydrolysed sludge/wastewater. Five species of bacteria been tested for the bacteria-based biopesticides production were *Bacillus thuringiensis* ATCC33679, *Bacillus thuringiensis* ATCC10792, *Lysinibacillus sphaericus*, *Klebsiella pneumonia* and *Aeromonas hydrophillia*. The growth rate and sporulation were evaluated throughout the fermentation. *Bacillus thuringiensis* ATCC 10792 cultured in hydrolysed shrimp pond sludge were selected to be used for the bioassay due to the high growth rate ($7.44x10^7$±5.16 CFU/ml) and sporulation ($5.90x10^7$±7.88 CFU/ml). Hydrolysed shrimp pond sludge also significantly showed higher growth rate and sporulation compared to unhydrolysed and supernantant. However, variability in the growth rate and sporulation also revealed the preference and requirement of each bacteria to grow and sporulate depends on the species. Further, effectiveness on the usage of alternate culture media was also evaluated on their entomotoxicity level. The bioassay of entomotoxicity test was carried out on the fruit fly larva (*Bactrocera dorsalis* Hendel) and 81.2% mortality was observed. Larval weight (0.019g ± 0.001) and size (6.97mm ± 0.97) observed on the treated larvae showed significant deterioration compared to the control larvae (with 0.027g ± 0.0003 weight and 10.08mm ± 0.22 in sizes). As well as, the pupation was disrupted in terms of the smaller size of the pupa (30% smaller) and thus, leading to a lower adult fly emergence rate

(65.25%). Furthermore, emerged adult fruit fly showed some physical abnormalities on the morphology (undeveloped, crumpled wings and cranked abdomen) and significantly affecting the survival rate of the flies (100% adult flies died after 4 days emerged from the pupa). Since the *Bt*-based biopesticides have been proven to affect the target insect (*B. dorsalis* Hendel), toxin produced by the bacteria have been identified. Protein separation conducted by SDS-Page showed the existence of a band with approximately 25 kDa molecular weight. The single band was prepared for protein identification using MALDITOF and three highest protein hits were obtained. The three protein hits identified were superoxide dismutase, spore coat protein and probable transaldolase. Among these three proteins identified, spore coat protein possess direct role in virulence towards the target insect. Therefore, it is strongly believed that this protein is the one that exerted the toxicity activities on the target insect with the presence of Cyt protein. On the whole, this study has proven the potential of *Bt* ATCC10792 cultured in shrimp pond sludge are able to produce effective biopesticides.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia
sebagai memenuhi keperluan untuk Ijazah Sarjana Sains

PENGHASILAN RACUN SERANGGA PEROSAK BIOLOGI MENGGUNAKAN ENAPAN KOLAM UDANG SEBAGAI KULTUR MEDIA MURAH BERPOTENSI DAN AKTIVITI ENTOMOTOKSIK KE ATAS LALAT BUAH (*Bactrocera dorsalis* HENDEL)

Oleh

NOORMASSHELA BINTI ULUL AZMI

April 2015

Pengerusi: Muskhazli Mustafa, PhD

Fakulti: Sains

Kawalan biologi ke atas serangga perosak dalam sektor perhutanan dan pertanian menggunakan bakteria telah terbukti meminimakan masalah yang berpunca daripada racun perosak kimia. Namun, aplikasinya adalah terhad kerana kos penghasilan melalui fermentasi yang tinggi. Oleh itu, adalah menjadi satu keperluan untuk menghasilkan kultur media alternatif yang berpontensi untuk menghasilkan racun perosak biologi berasaskan bakteria. Dalam kajian ini, enapan kolam udang dan air buangan digunakan sebagai kultur media alternatif untuk penghasilan racun perosak biologi berasaskan bakteria. Media alternatif ini telah disediakan dalam tiga keadaan; tanpa pra-rawatan (tanpa hidrolisis), rawatan asid (terhidrolisis) dan supernatan yang diperolehi selepas penggemparan enapan/air buangan terhidrolisis. Lima spesies bakteria telah diuji sebagai penghasil racun perosak biologi berasaskan bacteria ialah *Bacillus thuringiensis* ATCC33679, *Bacillus thuringiensis* ATCC10792, *Lysinibacillus sphaericus*, *Klebsiella pneumonia* dan *Aeromonas hydrophillia*. Kadar pertumbuhan dan sporulasi bakteria telah dinilai sepanjang fermentasi. *Bacillus thuringiensis* ATCC 10792 yang dikultur dalam enapan kolam udang terhidrolisis telah dipilih untuk digunakan dalam bioassai berdasarkan sebab kadar pertumbuhan ($7.44x10^7$±5.16 CFU/ml) dan sporulasinya ($5.90x10^7$±7.88 CFU/ml) yang tinggi. Enapan kolam udang terhidrolisis juga jelas menunjukkan kadar pertumbuhan dan sporulasi yang lebih tinggi berbanding tanpa hidrolisis dan supernatan. Walau bagaimanapun, variasi dalam kadar pertumbuhan dan sporulasi juga menunjukkan bahawa setiap bakteria mempunyai keutamaan dan keperluan berbeza untuk pertumbuhan dan menghasilkan spora mengikut spesis. Seterusnya, keberkesanan penggunaan kultur media alternatif juga dinilai berdasarkan tahap entomotoksiknya. Bioassai ujian entomotoksik telah dijalankan ke atas larva lalat buah (*Bactrocera dorsalis* Hendel) dan sebanyak 81.2% mortaliti telah diperhatikan. Kemerosotan berat (0.019g ± 0.001) dan saiz (6.97mm ± 0.97) larva yang ketara telah diperhatikan pada larva yang dirawat berbanding larva kawalan (dengan berat 0.027g ± 0.0003 dan saiz 10.08mm ± 0.22). Di

samping itu, proses pempupaan juga telah terganggu dengan saiz pupa yang lebih kecil (30% lebih kecil) dan kadar kemunculan lalat dewasa yang rendah (65.25%). Sementara itu, lalat buah dewasa yang telah terhasil menunjukkan beberapa keabnormalan fizikal pada morfologinya dan ianya telah memberi kesan ke atas kadar kemandirian lalat tersebut (100% lalat mati selepas 4 hari muncul dari pupa). Oleh kerana racun serangga biologi berasaskan *Bt* telah terbukti memberi kesan ke atas serangga sasaran (*B. dorsalis* Hendel), toksin yang dihasilkan oleh bakteria telah dikenalpasti. Pengasingan protein yang dijalankan dengan SDS-Page menunjukkan kewujudan satu jalur dengan anggaran berat molekul sebanyak 25 kDa. Jalur tunggal itu digunakan untuk pengenalpastian protein menggunakan MALDITOF dan tiga jenis protein tertinggi telah diperolehi. Tiga jenis protein yang telah dikenalpasti ialah superoksida dismutase, protein pembalut spora dan probable transaldolase. Antara tiga protein yang telah dikenalpasti ini, protein pembalut spora mempunyai peranan secara langsung didalam virulens terhadap serangga sasaran. Oleh sebab itu, adalah amat diyakini bahawa protein inilah yang telah mendorong aktiviti ketoksikan terhadap serangga sasaran dengan kehadiran protein Cyt. Secara keseluruhannya, kajian ini telah membuktikan potensi *Bt* ATCC10792 yang dikultur di dalam enapan kolam udang berupaya menghasilkan racun perosak biologi efektif.

ACKNOWLEDGEMENTS

Foremost, I would like to express my sincere gratitude to my supervisor, Associate Professor Dr. Muskhazli Mustafa for the continuous support of my study and research, for his faith, patience, motivation, enthusiasm, and immense knowledge. His guidance helped me in all the time of research and writing of this thesis.

My sincere thanks also go to my co-supervisor Dr. Nor Azwady Abd. Aziz for his comments and ideas. My appreciation and thanks to the staff of Plant Systematic and Microbiology Laboratory, Kak Leen and Kak Fara for their generous assistance in helping me throughout this study.

I thank my fellow labmates Shasya, Safiya and Jee Yin for the stimulating discussions, for the time we were working together and for all the fun we have had in the last few years.

Last but not least, I would like to thank my parents for the support and patience during my study period.

I certify that a Thesis Examination Committee has met on 10 April 2015 to conduct the final examination of Noormasshela Binti Ulul Azmi on her thesis entitled "Bacteria-based Biopesticides Production Using Shrimp Pond Sludge As Potential Cheap Culture Media And Entomotoxicity Activity Against Fruit Flies (*Bactrocera Dorsalis* Hendel)" in accordance with the Universities and University Colleges Act 1971 and the Constitution of the Universiti Putra Malaysia [P.U.(A) 106] 15 March 1998. The Committee recommends that the student be awarded the Master of Science.

Members of the Thesis Examination Committee were as follows:

Rusea Go, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Hishamuddin Omar, PhD
Senior Lecturer
Faculty of Science
Universiti Putra Malaysia
(Internal Examiner)

Jualang Azlan Gansau, PhD
Associate Professor
Universiti Malaysia Sabah
Malaysia
(External Examiner)

ZULKARNAIN ZAINAL, PhD
Professor and Deputy Dean
School of Graduate Studies
Universiti Putra Malaysia

Date: 17 June 2015

This thesis was submitted to the Senate of Universiti Putra Malaysia and has been accepted as fulfilment of the requirement for the Master of Science. The members of the Supervisory Committee were as follows:

Muskhazli Mustafa, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Chairman)

Nor Azwady Abd. Aziz, PhD
Associate Professor
Faculty of Science
Universiti Putra Malaysia
(Member)

_____

BUJANG BIN KIM HUAT, PhD
Professor and Dean
School of Graduate Studies
Universiti Putra Malaysia

Date:

Declaration by graduate student

I hereby confirm that:

- this thesis is my original work;
- quotations, illustrations and citations have been duly referenced;
- this thesis has not been submitted previously or concurrently for any other degree at any other institutions;
- intellectual property from the thesis and copyright of thesis are fully-owned by Universiti Putra Malaysia, as according to the Universiti Putra Malaysia (Research) Rules 2012;
- written permission must be obtained from supervisor and the office of Deputy Vice-Chancellor (Research and Innovation) before thesis is published (in the form of written, printed or in electronic form) including books, journals, modules, proceedings, popular writings, seminar papers, manuscripts, posters, reports, lecture notes, learning modules or any other materials as stated in the Universiti Putra Malaysia (Research) Rules 2012;
- there is no plagiarism or data falsification/fabrication in the thesis, and scholarly integrity is upheld as according to the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) and the Universiti Putra Malaysia (Research) Rules 2012. The thesis has undergone plagiarism detection software.

Signature: _____ Date: _____

Name and Matric No.: _____

Declaration by Members of Supervisory Committee

This is to confirm that:

- the research conducted and the writing of this thesis was under our supervision;
- supervision responsibilities as stated in the Universiti Putra Malaysia (Graduate Studies) Rules 2003 (Revision 2012-2013) are adhered to.

Signature:	
Name of Chairman of Supervisory Committee:	Assoc. Prof. Dr. Muskhazli Mustafa
Signature:	
Name of Member of Supervisory Committee:	Assoc Prof. Dr. Nor Azwady Abd. Aziz

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

LIST OF ABBREVIATIONS

ATCC	American Type Culture Collection
Bt	*Bacillus thuringiensis*
CFU/ml	Colony forming unit per mililiter
°C	Degree Celcius
δ	Delta
g	Gram
HCl	Hidrogen chloride
h	Hour
kDa	KiloDalton
LC_{50}	Lethal concentration 50
µl	Micro liter
mg	Miligram
ml	Mililiter
mmol	Milimole
min	Minute
NCBI	National Center for Biotechnology Information
NA	Nutrient agar
NB	Nutrient broth
%	Percentage
R_f	Retention value
rpm	Round per minute
NaCl	Sodium chloride
spp.	Species (plural)
sp.	Species (singular)
H_2SO_4	Sulphuric acid
V	Volt
v/v	Volume over volume
w/v	Weight over volume

CHAPTER 1

INTRODUCTION

Continuous rise in the number of population throughout the world has generated the demand of producing more foodstuffs for the global needs (Tirado-Montiel *et al*., 2001). Agriculture and forestry sector has been developed rapidly as a critical resource to satify the demand (Glare *et al*., 2012). Notwithstanding, in our urge to sustain and fulfil the requirement, some of the principal factors in these sectors have been causing damage to the environment. Most significantly, chemicals pesticides have been widely used in field crops for pest control and to increase crop yields.

Application of chemical pesticides to control pest are detrimental for the environment and produce considerable damage to the ecosystem (Wan *et al*., 2013). Chemical pesticides are primarily difficult to degrade, able to accumulate in the environment and consequently may contaminate water sources and foodstuffs (Alberola *et al*., 1999). On top of that, some chemical pesticides can act on the non-target organism specifically the human. Van der Werf (1996) stated that due to their inherent toxicity, pesticides may affect other organisms by triggering detrimental side-effects and subsequently affects the whole communities and ecosystem. Thus, the use of chemical pesticides present some serious side effects even thought it is known as an effective way to increase the percentage of higher yield.

These days, consumers have given careful consideration to the potential wellbeing effect on the usage of chemical pesticides in the production of food sources and their contamination towards environment (Czaja *et al*., 2014). Hence, there is an urgent need to discover an alternative approach to avoid the usage of these chemical pesticides. Biological control appears to constitute an alternative strategy for controlling pest, in this manner decreasing the application of chemical pesticides and contributing to the preservation of the nature (Souto *et al*., 2004).

Fundamentally, biopesticides usually exert less toxic than chemical pesticides. It generally can only affect the target organism and close-related organism, rather than the broad range, conventional chemical pesticides (Gupta and Dikshit, 2010). Biopesticides regularly are powerful in small amounts and decay rapidly. Thus, avoiding the environmental contamination caused by chemical pesticides since the exposures towards environment are reduced.

A biological pesticide is compelling just on the off chance that it has a potential significant effect towards the target pest, market size, successful field performance, low cost production, opinion from the end-user and various technological challenges such as culture condition, formulation and conveyance frameworks (Smitha *et al*., 2013). Cost for development, time and simplicity of registering and impending rising market on the contrary to

chemical pesticides make biopesticides intriguingly advocates to develop (Brar *et al*., 2006). Hence, to use biopesticides effectively, proper preparation and planning is important to consistently maintain the performance of the bipesticides.

A number of biopesticides (virus, bacteria, fungi, plant extracts and pheromones) have been commonly used to control different species of pest in forestry and agricultural sector (Copping and Menn, 2000). *Bacillus pumilus, B. thuringiesis, B. subtilis, Streptomyces* spp., and *Pseudomonas* spp. are among the bacteria that successfully used as biopesticides (Raudales and Gardener, 2008). Despite the increased interest in biologicals for biopesticides in recent years, Vu *et al*. (2010) revealed that biopesticides have not yet be able to replace chemical pesticides in pesticide market.

Obviously, there are some reasons contribute to the weak penetration of biopesticides in the market. For instance, toxicity exerted by biopesticides is slow action and remain only for a short time (Lachhab *et al*., 2001). Lack of studies on their mode of action also affects the marketing strategies. Other than that, economically there are various issues in production, high cost and short expiry duration.

In commercial bacteria-based biopesticides production, 30-40% from the total cost is the cost for the raw materials depending on the capacity of the production (El-Bendary, 2006; Chang *et al*., 2007). Subsequently, local biopesticides production in evolving countries should rely upon the usage of raw materials that are cheap, easily accessible such as by-products from agriculture or industrial sector (Fadel and Sabour, 2002). El-Bendary (2006) also reported that for a large scale production of biopesticides, distinctive methodologies ought to be examined to develop alternate media that are able to sustain sporulation and production of toxin in sensible costs.

A number of reported studies utilized alternative media for the bacteria based biopesticides production as the substrate were successfully replaced with wastewater sludge and agro-industrial wastes (rice straw, wheat bran, corn steep liquor, maize starch, etc.) (Tirado-Montiel *et al.*, 2001; Lachhab *et al.*, 2001; Vidyarthi *et al.*, 2002; Brar *et al.*, 2004; Yezza *et al.*, 2004, 2005; Zhuang *et al.*, 2010). In fact, application of wastewater as an alternative raw material in generating value-added products is a lot better than the conventional management of sludge disposal such as landfilling and incineration (Zhuang *et al*., 2011). Wastewater provides a good source of nutrients (nitrogen, carbon, phosphorus, etc) for the microbial biological processes that validated its potential to be used as alternate fermentation media for the production of biopesticides, specifically bacteria-based biopesticides (Vidyarthi *et al*., 2002; Yezza *et al*., 2004, 2005, 2006; Brar *et al*., 2009).

On the other hand, shrimp pond sludge is other option for the high-cost production problems of bacteria-based biopesticides. Periodic discharge of shrimp pond sludge to maintain the water quality in the pond is one of critical issues feared as the discharged effluent bring along high concentrations of suspended solids and nutrients, predominantly nitrogen (N) that can disrupt the ecosystem (Jackson *et al*., 2003). The release of high loads of nutrients and

suspended solids can possibly have unfavorable consequences on the receiving waters causing algal blooming and anoxic conditions (Islam *et al*., 2004).

Hence, using sludge or wastewater as a raw material for the production of biopesticide offers a practical clean-up alternative for sludge or wastewater disposal, and provides an economical production as alternative media for commercialization. The potential of shrimp pond sludge and wastewater as alternative media for biopesticides production needed to be explored and developed in our quest to find the solution of the high-cost production on the raw materials.

This study aims to evaluate the effectiveness of the bacteria-based biopesticides production in alternative culture media against the target insect. This study was divided into three experiments, each with its own objective. Five strains of bacteria were selected as potential bacteria-based biopesticides. Evaluation on growth and sporulation of each bacteria in the alternative culture media (shrimp pond sludge and wastewater) was conducted to proceed with the bacteria-based biopesticides production on the target pest, the larva of fruit-flies (*Bactrocera dorsalis* Hendel). Once the entomotoxicity level of the bacteria-based biopesticides have been determined and justified, identification of the bioactive compound produce by the bacteria-based biopesticides that was conducted.

Therefore, our objectives are:

1. to evaluate the growth performance and sporulation of bacteria in different alternative culture media.
2. to determine the entomotoxicity activity of the selected bacteria-based biopesticides and alternative culture media against the target insect, the larva of fruit-flies (*Bactrocera dorsalis* Hendel).
3. to identify the bioactive compound in the bacteria-based biopesticides produced.

REFERENCES

Adams, T.T., Eiteman, M.A. and Hansel, B.M. (2002). Solid-state fermentation of broiler litter for production of biocontrol agents. *Bioresource Technology*, 82: 33-41.

Ademolu, K.O. and Idowu, A.B. (2011). Occurrence and distribution of microflora in the gut regions of the variegated grasshopper *Zonocerus variegatus* (Orthoptera: Pyrgomorphidae) during development. *Zoological Studies*, 50: 409–415.

Adjalle, K.D., Brar, S.K., Verma, M., Tyagi, R.D., Valero, J.R.and Surampalli, R.Y. (2007).Ultrafiltration recovery of entomotoxicity from supernatant of *Bacillus thuringiensis* fermented wastewater and wastewater sludge. *Process Biochemistry* 42: 1302–1311.

Agaisse, H. and Lereclus,D. (1995). How does *Bacillus thuringiensis* produce so much insecticidal crystal protein?. *Journal of Bacteriology* 177: 6027–6032.

Ahmed, I., Yokota, A., Yamazoe, A. and Fujiwara, T. (2007). Proposal of *Lysinibacillus boronitolerans* gen. nov. sp. nov., and transfer of *Bacillus fusiformis* to *Lysinibacillus fusiformis* comb. nov. and *Bacillus sphaericus* to *Lysinibacillus sphaericus* comb. nov. *International Journal of Systematic and Evolutionary Microbiology*, 57: 1117–1125.

Aketarawong, N., Bonizzoni, M., Thanaphum, S., Gomulski, L.M., Gasperi, G., Malacrida, A.R. and Gugliemino, C.R. (2007). Inferences on the population structure and colonization process of the invasive oriental fruit fly, *Bactrocera dorsalis* (Hendel). *Molecular Ecology*, 16: 3522-3532.

Alberola, T.M., Aptosoglou, S., Arsenakis, M., Bel, Y., Delrio, G., Ellar, D.J., Ferre, J., Granero, F., Guttmann, D.M., Koliais, S., Martínez-Sebastian, M.J., Prota, R., Rubino, S., Satta, A., Scarpellini, G., Sivropoulou, A. and Vasara, E. (1999). Insecticidal activity of strains of *Bacillus thuringiensis* on larvae and adults of *Bactrocera oleae* Gmelin (Dipt. Tephritidae). *Journal of Invertebrate Pathology*, 74: 127–136.

Allen, R.C., Rogeli, S., Cordova, S. and Kief, T.L. An immuno-PCR method for detecting *Bacillus thuringiensis* Cry1Ac toxin. *Journal of Immunological Methods*, 308: 109-115.

Allwood, A.J. (2000). Fruit flies in Vanuatu. *Secretariat of the Pacific Community Pest Advisory Leaflet*, 27: 1-4.

Allwood, A.J. and **Leblanc, L. (**1997). Losses caused by fruit flies (Diptera:Tephritidae) in Seven Pacific Island Countries. In *A regional symposium, Nadi, Fiji 28-31 October 1996. ACIAR Proceedings No. 76, Management of Fruit Flies in the Pacific*, ed A.J. Allwood and R.A.I. Drew. pp. 208-211. Canberra, Australia: Australian Center for International Agricultural Research.

Alves, A.P., Spencer, T.A., Tabashnik, B.E. and Siegfried, B.D. (2006). Inheritance of resistance to the Cry1Ab *Bacillus thuringiensis* toxin in *Ostrinia nubilalis* (Lepidoptera: Crambidae), *Journal of Economic Entomology*, 99: 494–501.

Alyokhin, A.V., Mille, C., Messing, R.H. and Duan, J.J. (2001). Selection of pupation habitats by oriental fruit fly larvae in the laboratory. *Journal of Insect Behavior*, 14: 57-67.

Amin, G., Alotaibi, S., Youssef, N.A. and Saleh, W. (2008). Optimization of a fermentation process for bioinsecticide production by *Bacillus thuringiensis*. *World* Journal of *Microbiology* and *Biotechnology*, 24: 2465–2471.

Anand, S. and Reddy, J. (2009). Biocontrol potential of *Trichoderma* sp. against plant pathogens. *International Journal of Agricultural Science*, 2: 30–39.

Andow, D.A. and Zwahlen, C. (2006). Assessing environmental risks of transgenic plants. *Ecology Letters*, 9: 196–214.

Angerbaur, C., Siebenhofer, M., Mittelbach, M. and Guebitz, G.M. (2008). Conversion of sewage sludge into lipids by *Lipomyces starkeyi* for biodiesel production. *Bioresource Technology*, 99: 3051–3056.

Anjum, S., Razag, M. and Yazadni, M.S. (2000). Studies on seasonal activity and control of fruit flies (*Dacus* spp.) on mango (*Mangifera indica*) at Faisalabad, Pakistan. *Arab Journal of Plant Protection*, 18:121–123.

Ansari, M.S., Ahmad, N. and Hasan, F. (2012). Potential of Biopesticides in Sustainable Agriculture. In *Environmental Protection Strategies for Sustainable Development*, ed. A. Malik and E. Grohmann, E., pp 529-595. India: Springer Netherlands.

APHA, AWWA & WPCF (1989). *Standard Methods for Examination of Water and Wastewaters*. Washington DC, USA: American Public Health Association.

Aronson, A. (2002). Sporulation and delta-endotoxin synthesis in *Bacillus thuringiensis*. *Cellular and Molecular Life Sciences*, 59: 417–425.

Aronson, A.I., Tyrell, D.J., Fitz-James, P.C. and Bulla Jr, L.A. (1982). Relationship of the syntheses of spore coat protein and parasporal crystal protein in *Bacillus thuringiensis*. *Journal of Bacteriology*, 151: 399–410.

Arora, N., Ahmad, T., Rajagopal, R. and Bhatnagar, R.K.A. (2003). Constitutively expressed 36 kDa exochitinase from Bacillus thuringiensis HD-1. *Biochemical and Biophysical Research Communications*, 307: 620–625.

Arrieta, G., Hernandez, A. and Espinoza, A.M. (2004). Diversity of *Bacillus thuringiensis* strains isolated from coffee plantations infested with the coffee berry borer *Hypothenemus hampei*. *Revista de Biologia Tropical*, 52: 757 - 764.

Ashfaq, M., Young, S.Y. and McNew, R.W. (2001). Larval Mortality and Development of Pseudoplusia includes (Lepidoptera: Noctuidae) Reared on a Transgenic *Bacillus thuringiensis*-Cotton Cultivar Expressing CrylAc Insecticidal Protein. *Journal of Economic Entomology,* 94: 1053-1058.

Auld, B.A. and Monn, L. (1995). Constraints in the development of bioherbicides. *Weed Technology,* 9: 638–652.

Avnimelech, Y. and Ritvo, G. (2003). Shrimp and fish pond soils: processes and management. *Aquaculture,* 220: 549–567.

Baillie, L., Hibbs, S., Tsai, P.,Cao, G.L. and Rosen, G.M. (2005). Role of superoxide in the germination of *Bacillus anthracis* endospores. *FEMS Microbiology Letters,* 245: 33–38.

Barnabe, S., Tyagi, R.D., Valero, J.R. and Verma, M. (2006). Culture media for increasing biopesticide producing microorganisms' pesticidal activity, methods of producing same, biopesticide producing microorganisms so produced. *Patenscope*, 490.

Barranco-Florida, J.E., Alatorre-Rosas, R., Gutierrez-Rojas, Viniegra-Gonzalez and Saucedo-Casteneda. (2002). Criteria for the selection of strains of entomopathogenic fungi *Verticillium lecanii* for solid state cultivation. *Enzyme Microbial Technology,* 30: 910-915.

Beegle, C.C. (1990). Bioassay methods for quantification of *Bacillus thuringiensis* delta-endotoxin. In *Analytical Chemistry of Bacillus thuringiensis*, ed. L.A. Hickle and W.L. Fitch, pp.14–21. Washington, DC: American Chemical Society.

Ben Khedher, A., Jaoua, S. and Zouri, N. (2011). Improvement of bioinsecticides production by sporeless *Bacillus thuringiensis* strains in response to various stresses in low cost medium. *Current Microbiology*, 62: 1467–1477.

Bennetova, B. and Fraenkel, G. (1981). What determines the number of ovarioles in a fly ovary?. *Journal of Insect Physiology*, 27: 403–410.

Bergheim, A. and Asgard, T. (1996). Waste production from aquaculture. In *Aquaculture and Water Resource Management*, ed. D.J. Baird, M.C.M Beveride, L.A. Kelly and J.F. Muir, pp. 50–80. Oxford: Blackwell.

Bernard, K. and Utz, R. (1993). Production of *Bacillus thuringiensis* insecticides for experimental and commercial uses. In *Bacillus thuringiensis, An Environmental Biopesticide: Theory and Practice*, ed. P.F. Entwistle, J.S. Cory, M.J. Bailey and S. Higgs, pp. 255–267. New York: Wiley.

Berry, C. (2012). The bacterium, *Lysinibacillus sphaericus*, as an insect pathogen. *Journal of Invertebrate Pathology*, 109: 1–10.

Bertrand, G., Filiatre, C., Mahdjoub, H., Foissy, A. and Coddet, C. (2003). Influence of slurry characteristics on the morphology of spray dried alumina powders. *Journal of the European Ceramic Society* 23: 263–271.

Betz, F.S., Hammond, B.G. and Fuchs, R.L. (2000). Safety and advantages of *Bacillus thuringiensis*-protected plants to control insect pests. *Regulatory Toxicology and Pharmacology*, 32: 156–173.

Bhattacharya, P.R. (1993). *Bacillus thuringiensis* crystal protein (δ-endotoxin) gene expression is independent of early sporulation specific function. *Journal of Biosciences,* 18; 221-228.

Bio-Rad. *Tech Note 3133 Molecular weight determination by SDS-Page.* Bio-Rad Laboratories Inc.: USA, 2004.

Blanford, S. and Thomas, M.B. (2000). Thermoregulation in two acridid species: effects of habitat and season and implications for biological control using pathogens. *Environmental Entomology,* 29: 1060-1069.

Blanford, S., Thomas, M.B. and Langewald, J. (1998). Behavioural fever in a population of the Senegalese grasshopper, *Oedaleus senegalensis*, and its implications for biological control using pathogens. *Ecological Entomology,* 23: 9-14.

Bohn, T., Primicerio, R., Hessen, D.O. and Traavik, T. (2008). Reduced fitness of *Daphnia magna* fed a *Bt*-transgenic maize variety. *Archives of Environmental Contamination and Toxicology*, 55: 584–592.

Bone, L.W. and Tinelli, R. (1987). Trichostrongylus colubriformis: larvicidal activity of toxic extracts from *Bacillus sphaericus* (strain 1593) spores. *Experimental Parasitology*, 64: 514– 516.

Boyetchko, S., Pedersen, E., Punja, Z. and Reddy, M. (1999). Formulations of biopesticides In *Biopesticides: Use and Delivery*, ed. F.R. Hall and J.J. Menn, pp. 487-508. Ohio: Humana Press.

Bradford, M.M. 1976. A rapid and sensitive method for the quantitation of microgram quantities of protein utilizing the principle of protein-dye binding. *Analytical Bichemistry*. 72: 248-254.

Brar S.K., Verma M., Tyagi R.D., Valero J.R. and Surampalli R.Y. (2009). Entomotoxicity, protease and chitinase activity of *Bacillus thuringiensis* fermented wastewater sludge with high solid content. *Bioresource Technology*. 100: 4317-4325.

Brar, S.K., Verma, M., Tyagi, R.D., Valero, J.R. and Surampalli, R.Y. (2006). Efficient centrifugal recovery of *Bacillus thuringiensis* biopesticides from fermented wastewater and wastewater sludge. *Water Research* 40: 1310-1320.

Brar, S.K., Verma, M., Tyagi, R.D., Valero, J.R., Surampalli, R.Y. and Banerji, S. (2004). Comparative rheology and particle size analysis of various types of *Bacillus thuringiensis* fermented sludges. *Journal of Residuals Science* & *Technology* 1: 231–237.

Bravo, A. Likitvivatanavong, S., Gill, S.S. and Soberon, M. (2011). *Bacillus thuringiensis*: a story of a successful bioinsecticides. *Insect Biochemistry* and *Molecular Biology*, 41: 423–431.

Bravo, A., Gill, S.S. and Soberon, M. (2005). *Bacillus thuringiensis* mechanisms and use. In *Comprehensive Molecular Insect Science*, ed. L.I. Gillbert, I. Kostas and S.S. Gill, pp. 175–206. Oxford, UK: Elsevier.

Bravo, A., Gill, S.S. and Soberon, M. (2007). Mode of action of *Bacillus thuringiensis* Cry and Cyt toxins and their potential for insect control. *Toxicon*, 49: 423–435.

Bravo, A., Likitvivatanavong, S., Gill, S.S. and Soberon, M. (2011). *Bacillus thuringiensis*: a story of a successful bioinsecticide, *Insect Biochemistry* and *Molecular Biology,* 41: 423–431.

Broderick, N.A., Robinson, C.J., McMahon, M.D., Holt, J., Handelsman, J. and Raffa, K.F. (2009). Contributions of gut bacteria to *Bacillus thuringiensis*-induced mortality vary across a range of Lepidoptera. *BMC Biology*, 7: 11.

Brown, I.D., Watson, T.M., Carter, J., Purdie, D.M. and Kay, B.H. (2004). Toxicity of VectoLex (*Bacillus sphaericus*) products to selected Australian mosquito and nontarget species. *Journal of Economic Entomology*, 97: 51–58.

Burford, M.A. and Longmore, A.R. (2001). High ammonium production from sediments in hypereutrophic shrimp ponds. *Marine Ecology Progress Series*, 224: 187–195.

Burgerjon, A. and Biache, G. (1967). Diverse effets specianx et symptomes teratologiques de la toxine thermostable de *B. thuringiensis* en fonction de l'age physiologique des insects. *Annales- Societe Entomologique de France*, 3: 929-52.

Burgerjon, A., Biache, G. and Cals, P. (1969). Teratology of the Colorado potato beetle. *Leptinotarsa decemlineata,* as provoked by larval administration of the thermostable toxin of *Bacillus thuringiensis. Journal of Invertebrate Pathology,* 14: 274-278.

Cakici, F.O., Sevim, A., Demirbag, Z. and Demir, I. (2014). Investigating internal bacteria of *Spodoptera littoralis* (Boisd.) (Lepidoptera: Noctuidae) larvae and some *Bacillus* strains as biocontrol agents. *Turkish Journal of Agriculture and Forestry*, 38: 99-110.

Candas, M. and Bulla, L.A. (2002). Microbial insecticides. In *Encyclopedia of Environmental Microbiology*. ed. G. Bitton. pp. 1709–1717. New York: John Wiley and Sons.

Cannon, R.J.C. (1993) Prospects and progress for *Bacillus thuringiensis*-based pesticides. *Pesticide Science*, 37: 331–335.

Cantrell, C.L., Dayan, F.E. and Duke, S.O. (2012). Natural products as sources for new pesticides. *Journal of Natural Products*, 75: 1231-1242.

Cantwell, G.E. and Cantelo, W.W. (1981). *Bacillus thuringiensis* a potential control agent for the Colorado potato beetle. *The American Journal of Potato Research*, 58: 457-468.

Cantwell, G.E., Heimpel, A.M. and Thompson, M.J. (1964). The production of an exotoxin by various crystal-forming bacteria related to *Bacillus thuringiensis vat. thuringiensis* Berliner. *Journal of Invertebrate Pathology*, 6: 466-80.

Carlberg, G., Kihamia, C.M. and Minjas, J. (1985). Microbial control of flies in latrines in Dares Salaam with a *Bacillus thuringiensis* (serotype 1) preparation, Muscabac. *World Journal of Microbiology and Biotechnology*, 1: 33–44.

Carlton, B.C. (1995). Development and commercialization of new and improved biopesticides. *Annals New York Academy of Sciences* 1: 154-165.

Chang, M., Zhou, S., Lu, N. and Jin-ren, N. (2007). Enhanced *Bacillus thuringiensis* Production from Sewage Sludge with Alkaline and Ultrasonic Pretreatments. *Water*, *Air* and *Soil Pollution* 186:75–84.

Chang, M., Zhou, S., Lu, N. and Ni, J. (2007). Enhanced *Bacillus thuringiensis* production from sewage sludge with alkaline and ultrasonic pretreatments. *Water*, *Air*, *and Soil Pollution*, 186: 75-84.

Chattopadhyay, A., Bhatnagar, N.B. and Bhatnagar, R. (2004). Bacterial insecticidal toxins. *Critical Reviews in Microbiology*, 30: 33–54.

Chen, W., Li, Y., Du, G. and Chen, J. (2005). Application of resposnse surface methodology in medium optimization for spore production of *Coniothyrium minitans* in solid-state fermentation. *World Journal of Microbiology & Biotechnology,* 21: 593-599.

Choi, K.H., Lai, V., Foster, C.E., Morris, A.J., Tolan, D.R. and Allen, K.N. (2006). New superfamily members identified for Schiff-Base enzymes based on verification of catalytically essential residues. *Biochemistry*, 45: 8546–8555.

Choudhary, A. and Sharma, D.C. (2008). Pesticide residues in honey samples from Himachal Pradesh (India). *The Bulletin of Environmental Contamination* and *Toxicology*, 80: 417–422.

Christenson, L.D. and Foote, R.H. (1960). Biology of fruit flies. *Annual Review of Entomology*, 5: 171-192.

Cini, A., Anfora, G., Escudero-Colomar, L.A., Grassi, A., Santosuosso, U., Seljak,G. and Papini, A. (2014). Tracking the invasion of the alien fruit pest *Drosophila suzukii* in Europe. *Journal of Pest Science*, 87: 559-566.

Clausen, G.P., Claney, D.W. and Chock, Q.C. (1965). Biological control of the oriental fruitfly (*Dacus dorsalis* Hendel) and other fruitflies in Hawaii. *United States Department of Agriculture Technical Bulletin*, 1322: 1-102.

Copping, L.G. and Menn, J.J. (2000). Biopesticides: a review of their action, applications and efficacy. *Pest Management Science* 56: 651-676.

Crickmore, N., Baum, J., Bravo, A., Lereclus, D., Narva, K., Sampson, K., Schnepf, E., Sun, M. and Zeigler, D.R. (2014). *Bacillus thuringiensis* toxin nomenclature. http://www.btnomenclature.info/

Culliney, T.W. (2002). The aliens have landed: invasive species threaten Hawaii agriculture. *Agriculture Hawaii*, 3: 6-9.

Cuperus, G.W., Berberet, R.C. and Noyes, R.T. (2004). The essential role of IPM in promoting sustainability of agricultural production systems for future generations. In *Integrated pest management: potential, constraints and challenges*, ed. O. Koul, G.S. Dhaliwlal and G. Cuperus, pp 265-280. Wallingford, UK: CAB Internat.

Czaja, K., Goralczyk, K., Struci´nski, P., Hernik, A., Korcz, W., Minorczyk, M., Lyczewska, M. and Ludwicki, J.K. (2014). Biopesticides – towards increased consumer safety in the European Union. *Pest Management Science*. 161: 403-408.

Darboux, I., Nielsen-LeRoux, C., Charles, J.F. and Pauron, D. (2001). The receptor of *Bacillus sphaericus* binary toxin in *Culex pipiens* (Diptera: Culicidae) midgut: molecular cloning and expression. *Insect Biochemistry* and *Molecular Biology*, 31: 981–990.

David, K.J., Kumar, A.R.V. and Ramani, S. (2008). Distribution of *Bactrocera macquart* (Diptera: Tephritidae) in Kerala with special reference to the Western Ghats*. Journal of the Entomological Research Society*, 10: 55-69.

Davidson, E.W., Morton, H.L., Moffertt, J.O. and Singer, S. (1977). Effect of *Bacillus sphaericus* Strain SSII-1 on Honey Bees, Apis-Mellifera. *Journal of Invertebrate Pathology*, 29: 344–346.

de Maagd, R.A., Bravo, A. and Crickmore, N. (2001). How *Bacillus thuringiensis* has evolved specific toxins to colonize the insect world. *Trends in Genetics,* 17: 193–199.

Delafield, F.P., Somerville, H.J. and Rittenberg, S.C. (1968). Immunological homology between crystal and spore protein of *Bacillus thuringiensis*. *Journal of Bacteriology,* 96: 713–729.

Demir, I., Eryuzlu, E. and Demirbag, Z. (2012). A study on the characterization and pathogenicity of the bacteria from *Lymantria dispar* L. (Lepidoptera: Lymantriidae). *Turkish Journal of Biology*, 36: 459–468.

Desser, H. and Broda, E. (1965). Radiochemical determination of the endogenous and exogenous respiration of bacterial spores. *Nature*, 206: 1270–1271.

Devaraja, T.N., Yusoff, F.M. and Shariff, M. (2002). Changes in bacterial populations and shrimp production in ponds treated with commercial microbial products. *Aquaculture*, 206: 245–256.

Devidas, P.C., Pandit, B.H. and Vitthalrao, P.S. (2014). Evaluation of different ulture Media for improvement in bioinsecticides production by indigenous *Bacillus thuringiensis* and their application against larvae of *Aedes aegypti. The Scientific World Journal,* 2014: 1-6.

Dively, G.P., Rose, R., Sears, M.K., Hellmich, R.L., Stanley-Horn, D.E., Calvin, D.D., Russo, J.M. and Anderson, P.L. (2004). Effects on monarch butterfly larvae (Lepidoptera: Danaidae) after continuous exposure to Cry1Ab-expressing corn during anthesis. *Environmental Entomology*, 33: 1116-1125.

Dominguesa, F.C., Queiroza, J.A., Cabralb, J.M.S. and Fonsecab, L.P. (2000). The influence of culture conditions on mycelial structure and cellulose production by *Trichoderma reesei* RUT C-30. *Enzyme and Microbial Technology*, 26: 394–401.

Donovan, W.P., Engleman, J.T., Donovan, J.C., Baum, J.A., Bunkers, G.J., Chi, D.J., Clinton, W.P., English, L., Heck, G.R. and Ilagan, O.M. (2006). Discovery and characterization of Sip1A: A novel secreted protein from *Bacillus thuringiensis* with activity against coleopteran larvae. *Applied Microbiology and Biotechnology*, 72: 713–719.

Drew, R.A.I. and Hancock, D.L. (1994). The *Bactrocera dorsalis* complex of fruit flies (Diptera: Tephritidae: Dacinae) in Asia. *Bulletin of Entomological Research*, 84: 68.

Drew, R.A.I., Tsuruta, K. and White, I.M. (2005). A new species of pest fruit fly (Diptera: Tephritidae: Dacinae) from Sri Lanka and Africa. *African Entomology,* 13: 149-154.

Dricks, A. (2002). Maximum shields: the assembly and function of the bacterial spore coat. *Trends* in *Microbiology*, 10: 251–254.

Drouin, M., Lai, C.K., Tyagi, R.D. and Surampalli R.Y. (2008). *Bacillus licheniformis* proteases as high value added products from fermentation of wastewater sludge: pre-treatment of sludge to increase the performance of the process. *Water Science* and *Technology* 57: 423–429.

Dulmage, H.T. (1981). Microbial Control. In *Pests and Plant Diseases,* ed. H.D. Burges, pp. 193–220. New York, USA: Academic Press.

Duyck, P.F., David, P. and Quilici, S. (2004). A review of relationships between interspecific competition and invasions in fruit flies (Diptera: Tephritidae). *Ecological Entomology*, 29: 511-520.

Ejiofore, A.O. (1991). Production of *Bacillus thuringiensis* serotype H-14 as bioinsecticides using a mixture of spent brewer's yeast and waste cassava starch as the fermentation medium. *Disc Innovation* 3: 85–88.

Ekesi, S. and Mohamed, S.A. (2011). Mass rearing and quality control parameters for tephritid fruit flies of economic importance in Africa. In *Wide Spectra of Quality Control.* ed. I. Akyar. pp. 388-410. Crotia: InTech.

El-Bandary, M.A. (2006). *Bacillus thuringiensis* and *Bacillus sphaericus* biopesticides production. *Journal of Basic Microbiology*, 46: 158–170.

Elleuch, J., Tounsi, S., Hassen, N.B.B., Lacoix, M.N., Chandre, F., Jaoua, S. and Zghal, R.Z. (2015). Characterisation of novel *Bacillus thuringiensis* isolates against *Aedes aegypti* (Diptera: Culicidae) and *Ceratitis capitata* (Diptera: Tephridae). *Journal of Invertebrate Pathology*, 124: 90-97.

Errington, J. (1993). *Bacillus subtilis* sporulation: regulation of gene expression and control of morphogenesis. *Microbiology Reviews* 57: 1–33.

Estruch, J.J., Warren, G.W., Mullins, M.A., Nye, G.J., Craig, J.A. and Koziel, M.G. (1996). Vip3A, a novel *Bacillus thuringiensis* vegetative insecticidal protein with a wide spectrum of activities against lepidopteran insects. *Proceedings of the National Academy of Sciences USA*, 93: 5389–5394.

Fadel, M. and Sabour, M. (2002). Utilisation of diary byproduct in the production of bioinsecticide. *Journal of Biological Science*, 2: 116-120.

Federici, B.A. (2007). Bacteria as biological control agents for insects: economics, engineering, and environmental safety. In *Novel Biotechnologies for Biocontrol Agents Enhancement and Management*, ed. M. Vurro and J. Gressel, pp. 25–51. Dordrecht: Springer.

Fedoroff, N.V. (2012). Transposable elements, epigenetics, and genome evolution. *Science*, 338: 758-767.

Feitelson, J.S., Payne, J. and Kim, L. (1992). *Bacillus thuringiensis*: insects and beyond. *BioTechnology*, 55: 10271–10275.

Ferre, J. and Van Rie, J. (2002). Biochemistry and genetics of insect resistance to *Bacillus thuringiensis*. *Annual Review of Entomology*, 47: 501–533.

Flores S., Saxena D., Stotzky G. (2005). Transgenic *Bt* plants decompose less in soil than non-*Bt* plants. *Soil Biology and Biochemistry*, 37: 1073-1082.

Foote, R.H., Blanc, F.L. and Norrbom, A.L. (1993). *Handbook of the Fruit Flies (Diptera: Tephritidae) of America North of Mexico*. Ithaca, USA: Comstock.

Foster, S.J. and Johnstone, K. (1990). Pulling the trigger: the mechanism of bacterial spore germination. *Molecular Microbiology*, 4: 137–141.

Freire, I.S., Miranda-Vilela, A.L., Fascineli, M.L., Oliveira-Filho, E.C., Martins, E.S., Monnerat, R.G. and Grisolia C. K. (2014).Genotoxic evaluation in *Oreochromis niloticus* (Fish: Characidae) of recombinant spore–crystal complexes Cry1Ia, Cry10Aaand Cry1Ba6 from *Bacillus thuringiensis*. *Ecotoxicology*, 23: 267–272.

Fridovich I. (1995) Superoxide radical and superoxide dismutases. *Annual Review of Biochemistry,* 64: 97–112.

Gao, S., Lewis, G.D., Ashokkumar, M. and Hemar, Y. (2014). Inactivation of microorganisms by low-frequency high-power ultrasound: 1. Effect of growth phase and capsule properties of the bacteria. *Ultrasonics Sonochemistry*, 21: 446-453.

Gao, Y.Y.H., Fu, Q., Zhang, J.O.B., Lai, F., Peng, Y. and Zhang, Z. (2010). Screen of *Bacillus thuringiensis* toxins for transgenic rice to control *Sesamia inferens* and *Chilo suppressalis*. *Journal of Invertebrate Pathology,* 105: 11–15.

Geysen, S., Geeraerd, A.H., Verlinden, B.E., Michiels, C.W., Van Impe, J.F. and Nicolai, B.M. (2005). Predictive modelling and validation of *Pseudomonas fluorescens* growth at superatmospheric oxygen and carbon dioxide concentrations. *Food Microbiology*, 22: 149-158.

Ghribi, D., Zouri, N., Trigui, W. and Jaoua, S. (2007). Use of sea water as salts source in starch- and soya bean-based media, for the production of *Bacillus thuringiensis* bioinsecticides. *Water, Air, and Soil Pollution*, 186: 75-84.

Gijzen, M., Ishmael, C. and Shrestha, S.D. (2014). Epigenetic control of effectors in plant pathogens. *Frontiers in Plant Science*, 5: 1-4.

Giraldo, M.C. and Valent, B. (2013). Filamentous plant pathogen effectors in action. *Nature Reviews Microbiology*, 11: 800-814.

Glare, T., Caradus, J., Gelernter, W., Jackson, T., Keyhani, N., Kohl, J., Marrone, P., Morin, L. and Stewart, A. (2012). Have biopesticides come of age?. *Trends in Biotechnology* 30: 250-259.

Glare, T.R. and O'Callaghan, M. (2000). *Bacillus thuringiensis*. In *Biology, Ecology and Safety*. ed. Wiley, J., pp. 350. Chichester.

Glare, T.R. and O'Callaghan, M. (2003). Environmental Impacts of Bacterial Biopesticides. In *Progress in Biological Control,* ed. H.M.T. Hokkanen and A.E. Hajek, pp. 119-149. Netherlands: Springer.

Goodhue, R.E., Bolda, M., Farnsworth, D., Williams, J.C. and Zalom, F.G. (2011). Spotted wing drosophila infestation of California strawberries and raspberries: economic analysis of potential revenue losses and control costs. *Pest Management Science*, 67: 1396–1402.

Gouda, M.K., Swellam, A.E. and Omar, S. H. (2001). Production of PHB by a *Bacillus megaterium* strain using sugarcane molasses and corn steep liquor as sole carbon and nitrogen sources. *Microbiological Research*, 156: 201–207.

Gough, J.M., Kemp, D.H., Akhurst, R.J., Pearson, R.D. and Kongsuwan, K. (2005). Identification and characterization of proteins from *Bacillus thuringiensis* with high toxic activity against the sheep blowfly, *Lucilia cuprina. Journal of Invertebrate Pathology,*90: 39–46.

Greenberg, B. (1955). Fecundity and cold survival of the house fly. *Journal of Economic Entomology*, 48: 654–657.

Gringorten, J.L. (2001) Ion balance in the lepidopteran midgut and insecticidal action of *Bacillus thuringiensis*, In *Biochemical Sites of Insecticide Action and Resistance*, ed. I. Ishaaya, pp 167-207. Berlin, Germany: Springer Verlag.

Guan, P., Dai, X., Zhu, J., Li, Q., Li, S., Wang, S., Li, P and Zheng, A. (2014). *Bacillus thuringiensis* subsp. *sichuansis* strain MC28 produces a novel crystal protein with activity against *Culex quinquefasciatus* larvae. *World Journal of Microbiology and Biotechnology* 30: 1417-1421.

Guimaraes, D.A., Ramos, R.S., Garcia, G.W. and Ohashi, O.M. (2009). The stimulatory effect of male agouti (*Dasyprocta prymnolopha*) on the onset of female puberty. *Acta Amazonica*, 39: 759-762.

Gupta, S. and Dikshit, A.K. (2010). Biopesticides: An ecofriendly approach for pest control. *Journal of Biopesticides* 3: 186-188.

Hare, S.G.F. and Nasci, R.S. (1986). Effects of sublethal exposure to *Bacillus thuringiensis* Var Israelensis on larval development and adult size in *Aedes aegypti*. *Journal of American Mosquitoes Control Association,* 2: 325-328.

Hasan, E. and Gokce, A. (2014). Production and Consumption of Biopesticides. In *Advances in Plant Biopesticides*, ed. D. Singh, pp. 361-379. Australia: Springer India.

Hathout, Y., Demirev, P.A., Ho, Y.P., Bundy, J.L., Ryzhov, V., Sapp, L., Stutler, J., Jackman, J. and Fenselau, C. (1999). Identification of *Bacillus* spores by matrix-assisted laser desorption ionization-mass spectrometry. *Applied and Environmental Microbiology*, 65: 4313–4319.

Heap, I. (2014). Global perspective of herbicide-resistant weeds. *Pest Management Science*, 70: 1306-1315.

Henriques, A.O., Costa, T.V. and Martins, L.O. (2004). The functional architecture and assembly of the spore coat. In *Bacterial Spore Formers - Probiotics and Emerging Applications.* ed E. Ricca, A.O. Henriques and S.M. Cutting. pp. 65-86. Norfolk: Horizon Bioscience.

Henriques, A.O., Melsen, L.R. and Moran Jr, C.P. (1998). Involvement of superoxide dismutase in spore coat assembly in *Bacillus subtilis. Journal of Bacteriology,* 180: 2285-2291.

Hodgman, T. C., Ziniu, Y., Ming, S., Sawyer, T., Nicholls, C.M. and Ellar, D.J. (1993). Characterization of a *Bacillus thuringiensis* strain which is toxic to the house fly *Musca domestica*. *FEMS Microbiology Letters*, 114: 17–22.

Hofte, H. and Whitely, H.R. (1989). Insecticidal crystal proteins of *Bacillus thuringiensis*. *Microbiological Reviews*, 53: 242–255.

Huang Z.Y., Hanley A.V., Pett W.L., Langenberger M., Duan J.J. (2004). Field and semifield evaluation of impacts of transgenic canola pollen on surviva and development of worker honey bees, *Journal of Economic Entomology*, 97: 1517–1523.

Ibargutxi, M.A., Munoz, D., Ruiz de Escudero, I. and Caballero, P. (2008). Interactions between Cry1Ac, Cry2Ab, and Cry1Fa *Bacillus thuringiensis* toxins in the cotton pests *Helicoverpa armigera* (Hübner) and *Earias insulana* (Boisduval). *Biological Control*, 47: 89–96.

Ibarra, J.E. and Del Rincon-Castro, MC. (2001). Cuantificacion Toxicologica de *Bacillus thuringiensis*,. In *Bioinsecticidas: Fundamentos y Aplicaciones de Bacillus thuringiensis en el Control Integrado de Plagas*, ed. P. Caballero and J. Ferre, pp. 133-152. S.L. Valencia, Espana: M.V. Phytoma-Espana.

Ibrahim, M.A., Griko, N., Junker, M. and Bulla, L.A. (2010). *Bacillus thuringiensis*, a genomics and proteomics perspective. *Bioengineering Bugs*, 1: 31–50.

Indrasith, L.S., Suzuki, N., Ogiwara, K., Asano, S. and Hori, H. (1992). Activated insecticidal crystal proteins from *Bacillus thuringiensis* serovars killed adult house flies. *Letters in Applied Microbiology*, 14: 174–177.

Ishtiaq, A., Farman, U. and Alamkhan, S. (1999). Efficacy of various insecticides and trap heights in methyl eugenol baited traps against fruit flies (*Bactrocera* spp.). *Sarhad Journal of Agriculture*, 15: 589–594.

Islam, S., Sarker, J., Yamamoto, T., Wahab, A. and Tanaka, M. (2004). Water and sediment quality, partial mass budget and effluent N loading in coastal brackishwater shrimp farms in Bangladesh. *Marine Pollution Bulletin*, 48: 471–485.

Jackson, C.J., Preston, N., Burford, M.A. and Thompson, P.J. (2003) Managing the development of sustainable shrimp farming in Australia: the role of sedimentation ponds in treatment of farm discharge water. *Aquaculture* 226: 23-34.

Jacobsen, BJ. and Backman, P.A. (1993). Biological and cultural plant disease controls: Alternatives and supplements to chemicals in IPM systems. *Plant Disease*, 77: 311–315.

Jallouli, W., Sellami, S., Sellami, M. and Tounsie, S. (2014). Impact of liquid formulation based on ultrafiltration-recoveredbioactive components on toxicity of *Bacillus thuringiensis subsp.*kurstaki strain BLB1 against *Ephestia kuehniella*. *Process Biochemistry*

Janda, J.M. and Abbott, S.L. (2010). The genus Aeromonas: Taxonomy, pathogenicity, and infection. *Clinical Microbiology Reviews*, 23: 35–73.

Jisha, V.N., Smitha, R.B. and Benjamin, S. (2013). An overview on the crystal toxins from *Bacillus thuringiensis*. *Advances in Microbiology*, 3: 462-472.

Jogen, C.K. (2011). The use of biopesticides. *Insect Pest Management*, 1: 169-177.

Johnson, C., Bishop, A.H. and Turner, C.L. (1998). Isolation and activity of strains of *Bacillus thuringiensis* toxic to larvae of the housefly (Diptera: Muscidae) and tropical blowflies (Diptera: Calliphoridae). *Journal of Invertebrate Pathology*, 71: 138–144.

Johnson, D.E. and McGaughey, W.H. (1984). Insecticidal activity of spore-free mutants of *Bacillus thuringiensis* against the Indian-meal moth and almond moth. *Journal of Invertebrate Pathology*, 43: 156–159.

Johnson, D.E., Oppert, B. *and* McGaughey, W.H. *(*1998*)* Spore protein synergizes *Bacillus thuringiensis* crystal toxicity for the Indian meal Moth (*Plodia interpunctella*)*. Current Microbiology,* 36*:* 278–282*.*

Kabaluk, J.T., Antonet, M.S., Mark, S.G. and Stephanie, G.W. (2010). *The Use and Regulation of Microbial Pesticides in Representative Jurisdictions Worldwide*. USA: IOBC Global.

Kemp, M.J. and Dodds, W.K. (2002). The influence of ammonium, nitrate, and dissolved oxygen concentrations on uptake, nitrification and denitrification rates associated with prairie stream substrata. *Limnology and Oceanography*, 47: 1380–1393.

Key, P.B. and Scott, G.I. (1992). Acute toxicity of the mosquito larvicide, *Bacillus sphaericus*, to the grass shrimp, *Palaemonetes pugio*, and mummichog, *Fundulus heteroclitus*. *Bulletin of Environmental Contamination* and *Toxicology*, 49: 425–430.

Khandelwal, M., Datta, S., Mehta, J., Naruka, R., Makhijani, K., Sharma, G., Kumar, R. and Chandra, S. (2012). Isolation, characterization and biomass production of *Trichoderma viride* using various agro products-A biocontrol agent. *Advances in Applied Science Research,* 3: 3950–3955.

Khedher, S.B., Jaoua, S. and Zouari, N. (2013). Application of statistical experimental design for optimisation of bioinsecticides production by sporeless *Bacillus thuringiensis* strain on cheap medium. *Brazilian Journal of Microbiology*, 44: 34-39.

Kim, J.S., Lee, S.J., Skinner, M., Parker, B.L., Oh, B. and Lee, K. (2013). Relationship between endospore viability and insecticidal potency of *Bacillus thuringiensis subsp. aizawai* NT0423. *Biological Control* 58: 607–614.

Kim, T.K., Nama, Y.K., Park, C. and Lee, M. (2009). Carbon source recovery from waste activated sludge by alkaline hydrolysis and gamma-ray irradiation for biological denitrification. *Bioresource Technology* 100: 5694–5699.

Kiritani, K. (1998). Exotic insects in Japan. *Entomological Science*, 1: 291-298.

Klassen, W., Lindquist, D.A. and Buyckx, E.J. (1994). Overview of the joint FAO/IAEA Division's involvement in fruit fly sterile insect technique programs. In *Fruit Flies and the Sterile Insect Technique*, ed. C.O. Calkins, W. Klassen and P. Liedo, pp. 3-26. Boca Raton, Florida: CRC Press.

Kleter, G.A., Bhula, R., Bodnaruk, K., Carazo, E., Felsot, A.S. and Harris, C.A. (2007). Altered pesticide use on transgenic crops and the associated general impact from an environmental perspective. *Pest Management Science*, 63: 1107–1115.

Knowles, B.H. (1994). Mechanism of action of *Bacillus thuringiensis* insecticidal δ-endotoxins. *Advances in Insect Physiology*, 24: 275–308.

Kole, M.M., Draper, I. and Gerson, D.F. (1988). Production of protease by Bacillus subtilis using simultaneous control of glucose and ammonium concentrations. *Journal of Chemical Technology and Biotechnology*, 41: 197-206.

Kourtoglou, E., Mamma, D., Topakas, E. and Christakopoulos, P. (2008). Purification, characterization and mass spectrometric sequencing of transaldolase from *Fusarium oxysporum. Process Biochemistry,* 43: 1094–1101.

Koyama, J. (1989). Pest status; south-east Asia and Japan. In *World Crop Pests 3(A). Fruit flies; Their Biology, Natural Enemies and Control,* ed. A.S. Robinson and G. Hooper, pp. 63-66. Amsterdam, Netherlands: Elsevier.

Kraiss, H. and Cullen, E.M. (2008). Insect growth regulator effects of azadirachtin and neem oil on survivorship, development and fecundity of *Aphis glycines* (Homoptera: Aphididae) and its predator, *Harmonia axyridis* (Coleoptera: Coccinellidae). *Pest Management Science*, 64: 660–668.

Kramarz, P.E., de Vaufleury, A., Zygmunt, P.M. and Verdun, C. (2007). Increase response to cadmium and *Bacillus thuringiensis* maize toxicity in the snail *Helix aspersa* infected by the nematode *Phamarhabditis hermaphodita*, *Environmental Toxicology and Chemistry*, 26: 73–79.

Kumar, S. (2012). Biopesticides: A Need for Food and Environmental Safety. *Journal of Biofertilizers & Biopesticides, 3: 1-3.*

Kumar, S., Arul, L. and Talwar, D. (2010). Generation of marker-free *Bt* transgenic indica rice and evaluation of its yellow stem borer resistance. *Journal* of *Applied Genetics*, 51: 243-57.

Kumari, B., Madan, V.K. and Kathpal, T.S. (2008). Status of insecticide contamination of soil and water in Haryana, India. *Environmental Monitoring* and *Assessment*, 136: 239–244.

Kutasi, J., Arkas, R., Orzsonyi, L. and Ata, A. (2000). Examination of the inhibitory effects of a *Bacillus* species on the domestic fly. *Magyar Allatorvosok Lapja (Hungary)*, 122: 34–38.

Lacey, L.A. (2007). *Bacillus thuringiensis* serovariety israelensis and *Bacillus sphaericus* for mosquito control. *Journal of the American Mosquito Control Association*, 23: 133–163.

Lacey, L.A., Frutos, R., Kaya, H.K. and Vail, P. (2001). Insect pathogens as biological control agents: Do they have a future?. *Biological Control*, 21: 230-248.

Lachhab, K., Tyagi, R.D. and Valero, J.R. (2001). Production of *Bacillus thuringiensis* biopesticide using wastewater sludge as a raw material: Effect of inoculum and sludge solids concentration. *Process Biochemistry* 37: 197–208.

Laemmli, U.K. (1970). Cleavage of structural proteins during the assembly of the head of bacteriophage T4. *Nature*, 227: 680–685.

Larka, U.B., Ulett, D., Garrison, T. and Rockett, M.S. (2003). *Aeromonas hydrophila* infections after penetrating foot trauma. *Journal of Foot* & *Ankle Surgery*, 42: 305–308.

Lee, D.W., Akao, T., Yamashita, S., Katayama, H., Maeda, M. and Saitoh, H. (2000) Noninsecticidal parasporal proteins of a *Bacillus thuringiensis* serovar shandongiensis isolate exhibit a preferential cytotoxicity against human leukemic T cells. *Biochemical and Biophysical Research Communications*, 72: 218–223.

Lei, P., Ayton, S., Finkelstein, D.I., Spoerri, L., Ciccotosto, G.D., Wright, D.K., Wong, B.X.W., Adlard, P.A., Cherny, R.A., Lam, L.Q., Roberts, B.R., Volitakis, I., Egan, G.F., McLean, C.A., Cappai, R., Duce, J.A. and Bush, A.I. (2012). Tau deficiency induces parkinsonism with dementia by impairing APP-mediated iron export. *Nature Medicine,* 18: 291–295.

Leng, P., Zhang, Z, Pan, G. and Zhao, M. (2011). Applications and development trends in biopesticides. *African Journal of Biotechnology*, 10: 19864-19873.

Lewis, T.S., Hunt, J.B., Aveline, L.D., Jonscher, K.R., Louie, D.F., Yeh, J.M., Nahreini, T.S., Resing, K.A. and Ahn, N.G. (2000). Identification of novel MAP kinase pathway signalling targets by functional proteomics and mass spectrometry. *Molecular Cell*, 6: 1343-1354.

Li, Y., Shu, Y., Peng, C., Zhu, L., Guo, G. and Li, N. (2012). AQUIP: absolute quantitation of isoforms of post-translationally modified proteins in transgenic organism. *Molecular* & *Cellular Proteomics*, 11: 272–285.

Liang, Z., Liu, Y., Ge, F., Xu, Y., Tao, N., Peng, F. and Wong, M. (2013). Efficiency assessment and pH effect in removing nitrogen and phosphorus by algae-bacteria combined system of *Chlorella vulgaris* and *Bacillus licheniformis. Chemosphere*, 92: 1383-1389.

LianGen, C., ChunGang, Z. and XiNa, X. (2010). A preliminary study on the biological characters of Bactrocera dorsalis (Hendel) in Shanghai area. *Acta Agriculturae Shanghai*, 26: 99-101.

Lima, A.A., Pereira, M.P., Silva-Filho, R.G. and Hofer, E. (2007). Utilization of phenol in the presence of heavy metals by metal-tolerant nonfermentative Gram-negative bacteria isolated from wastewater. *Revista Latinoamericana de Microbiologia,* 49: 68–73.

Lisansky, S.G., Quilan, R. and Tassoni, G. (1993). *The Bacillus thuringiensis Production Handbook.* Newbury, UK: CPL Perss.

Logan, N.A. and Turnbull, P.C.B. (2003) *Bacillus* and other aerobic endospore-forming bacteria. In *Manual of Clinical Microbiology.* ed P. Murray. pp 445–460. Washington, D.C: ASS Press.

Lonc, E., Lecadet, M., Lachowicz, T.M. and Panek, E. (1997). Description of *Bacillus thuringiensis* wratislaviensis (H-47), a new serotype originating from Wroclaw (Poland), and other *Bt* soil isolates from the same area. *Letters in Applied Microbiology*, 24: 467–473.

Lopez, O., Fernandez-Bolanos, J.G. and Gil, M.V. (2005). New trends in pest control: the search for greener insecticides. *Green Chemistry*, 7: 431–442.

Lukasova, J., Vyhnalkova, J. and Pacova, Z. (2001). *Bacillus* species in raw milk and in the farm environment. *Milchwissenschaft-Milk Science International*, 56: 609–611.

Luna-Finkler, C.H. and Finkler, L. (2012). *Bacillus sphaericus* and *Bacillus thuringiensis* to insect control: Process development of small scale production to pilot-plant-fermenters, insecticides. In *Advances in Integrated Pest Management*, ed. F. Perveen, pp. 307-780. Crotia: InTech.

Ma, X., Zhou, W., Fu, Z., Cheng, Y., Min, M., Liu, Y., Zhang, Y., Chen, P. and Ruan, R. (2014). Effect of wastewater-borne bacteria on algal growth and nutrients removal in wastewater-based algae cultivation system. *Bioresource Technology*, 167: 8-13.

Margalith, Y. and Ben-Dov, E. (2000). Biological control by Bacillus thuringiensis subsp. israeliensis. In *Insect Pest Management: Techniques for Environmental Protection*, ed. J.E. Rechcigl and N.A. Rechcigl, pp. 243. Washington: CRC Press.

Marrone, P.G. (2007). Barriers to adoption of biological control agents and biological pesticides. *Biocontrol Science and Technology,* 4: 517–526

Marrone, P.G. and MacIntosh, S.C. (1993). Resistance to *Bacillus thuringiensis* and Resistance Management. In *Bacillus thuringiensis, An Environmental Biopesticide: Theory and Practice*, ed. P.F. Entwistle, J.S. Cory, M.J. Bailey and S. Higgs, pp. 221-235. Chichester, UK: John Wiley & Sons.

Marvier, M., Creedy, C.M., Regetz, J. and Karieva, P. (2007). A meta-analysis of effects of *Bt* cotton and maize on nontarget invertebrates. *Science*, 316: 1475-1477.

Mathavan, S., Velpandi, A. and Johnson, J.C. (1987). Sub-toxic effects of *Bacillus sphaericus* 1593 M on feeding growth and reproduction of *Laccotrephes griseus* (Hemiptera: Nepidae). *Experimental Biology*, 46: 149–153.

Mazid, S. and Kalita, J.C. (2011). A review on the use of biopesticides in insect pest management. *International Journal of Science* and *Advanced Technology,* 1: 169–178.

Mendelson, M., Kough, J., Vaituzis, Z. and Matthews, K. (2003). Are *Bt* crops safe?, *Nature Biotechnology*, 21: 1003–1009.

Merdan, A.B. (2012). *Bacillus thuringiensis* as a feed additive to control *Musca domestica* associated with poultry houses. *The Journal of Basic & Applied Zoology,* 65: 83-87.

Mikkola, R., Kolari, M., Andersson, M.A., Helin, J. and Salkinoja-Salonen, M.S., (2000). Toxic lactonic lipopeptide from food poisoning of *Bacillus licheniformis*. *European* Journal of *Biochemistry*, 267, 4068–4074.

Mindlin, S., Kholodii, G., Gorlenko, Z., Minakhina, S., Minakhin, L., Kalyaeva, E., Kopteva, A., Petrova, M., Yurieva, O. and Nikiforov, V. (2001) Mercury resistance transposons of Gram-negative environmental bacteria and their classification. *Research in Microbiology*, 152:811–822.

Miruka, D.O., Ochieng, J.O., Were, J.W. and Waindi, E.N. (2013). Microbial assessment of selected earthen fish ponds in western Kenya. *Ecohydrology & Hydrobiology*, 13: 261-266.

Mishra, J., Tewari, A., Singh, S. and Arora, N.K. (2014). In *Biopesticides: Where We Stand?* ed. Arora, N.K. pp. 37-75. Springer India. Uttar Pradesh, India.

Miwa, H., Ahmed, I., Yokota, A. and Fujiwara, T. (2009). *Lysinibacillus parviboronicapiens* sp.nov.,alow-boron-containing bacterium isolated from soil. *International Journal of Systematic and Evolutionary Microbiology*, 59: 1427–1432.

More, T.T., Yan, S., Hoang, N.V., Tyagi, R.D. and Surampalli, R.Y. (2012). Bacterial polymer production using pre-treated sludge as raw material and its flocculation and dewatering potential. *Bioresource Technology* 121: 425–431.

Morris, O.N., Conserve, V., Kanagaratnam, P. and Davies, J.S. (1996). Effect of cultural conditions on spore-crystal yield and toxicity of *Bacillus thuringiensis* subsp. aizawai (HD 133). *Journal of Invertebrate Pathology* 67: 129-136.

Moscardi, F., de Souza Lobo, M., de Castro Batista, M.E., Moscardi, L.M. and Szewczyk, B. (2011). Baculovirus pesticides – present state and future perspectives. In *Microbes and Microbial Technology*, ed. I. Ahmad, F. Ahmad and P. Pichtel, pp. 415-445. New York: Springer.

Mulligan, F.S., Schaefer, C.H. and Miura, T. (1978). Laboratory and field evaluation of *Bacillus sphaericus* as a mosquito (Diptera-Culicidae) control agent. *Journal of Economic Entomology,* 71: 774–777.

Mwamburi, L.A., Laing, M.D. and Miller, R. (2014). Interaction between *Beauveria bassiana* and *Bacillus thuringiensis* var. *israelensis* for the control of house fly larvae and adults in poultry houses. *Poultry Science*, 88: 2307–2314.

Nakamura, L.K., Shida, O., Takagi, H. and Komagata, K. (2002). *Bacillus pycnus* sp. *nov.* and *Bacillus neidei* sp. *nov.*, round-spored bacteria from soil. *International Journal of Systematic and Evolutionary Microbiology,* 52: 501–505.

Naylor, S., Brisson, J., Labelle, M.A. and Comeau, Y. (2003). Treatment of freshwater fish farm efluent using constructed wetlands: the role of plants and substrate. *Water Science and Technology* 48: 215-222.

Neppl, C.C. (2000). *Management of Resistance to Bacillus thuringiensis Toxins,* PhD Thesis, The University of Chicago.

Nicholson, W.L., Munakata, N. and Horneck, G. (2000). Resistance of *Bacillus* endospores to extreme terrestrial and extraterrestrial environments. *Microbiology and Molecular Biology Reviews*, 64: 548–572.

Nishiwaki, H., Nakashima, K., Ishida, C., Kawamura, T. and Matsuda, K. (2007). Cloning, functional characterization, and mode of action of a novel insecticidal pore-forming toxin, *Sphaericolysin*, produced by *Bacillus sphaericus. Applied and Environmental Microbiology*, 73: 3404–3411.

Noma, T. and Strickler, K. (2000). Effects of *Beauveria bassiana* on *Lygus hesperus* (Hemiptera: Miridae) feeding and oviposition. *Environmental Entomology,* 29: 394–402.

Nordmann, P., Cuzon, G., Naas, T. (2009). The real threat of Klebsiella pneumoniae carbapenemase-producing bacteria. *Lancet Infectious Diseases,* 9: 228-236.

O'Brien, K.P., Franjevic, S. and Jones, J. (2009). Green chemistry and sustainable agriculture: the role of biopesticides, advancing green chemistry. *Ecology*, 90: 2223-2232.

Oestergaard, J., Ehlers, R., Martinez-Ramirez, A.C. and Real, M.D. (2007). Binding of Cyt1Aa and Cry11Aa toxins of *Bacillus thuringiensis* Serovar *israelensis* to brush border membrane vesicles of *Tipula paludosa* (Diptera: Nematocera) and subsequent pore formation. *Applied and Environmental Microbiology,* 73: 3623-3629.

Okulate, M.A. (2009). Antimicrobial activity of bioactive compounds produced by Bacillus species. In *Final report for microbial diversity course*, pp. 1-14.

Oliveira, A.C.B., Wanderley-Teixeira, V., de Siquera, H.A.A., de Souza Alves, T.J., Ribeiro, L.M.S. and Teixeira, A.A.C. (2013). Immune response of *Alabama argillacea* (Hubner, 1818) (Lepidoptera: Noctuidae) treated with formulations of *Bacillus thuringiensis* Berliner. *Animal Biology*, 63: 343–355.

Onyenwoke, R.U., Brill, J.A.and Farahi, K. (2004). Sporulation genes in members of the low G+C Gram-type-positive phylogenetic branch (Firmicutes). *Archives of Microbiology*, 182: 182–192.

Palmer, D. (1999). Biopesticides.The Latest Technology. University of Florida. Parker, J.L. and Shaw, J.G. (2011). *Aeromonas* spp. clinical microbiology and disease. *Journal of Infection*, 62: 109-118.

Pankaj, P.K., Kumar, P., Nigam, R.C. and Mishra, P.K. (2012). Monitoring and surveillance of synthetic pyrethroids and organophosphate in different brands of soft drinks. *Journal of Chemical* and *Pharmaceutical Research,* 4: 3939–3943.

Partidge, M.R. and Berry, C. (2002). Insecticidal activity of the *Bacillus sphaericus* Mtx1 toxin against *Chironomus riparus. Journal of Invertebrate Pathology*, 79: 135–136.

Patil, C.C., Patil, S.V., Salunke, B.K. and Salunkhe, R.B. (2012). Insecticidal potency of bacterial species *Bacillus thuringiensis* SV2 and *Serratia nematodiphila* SV6 against larvae of mosquito species *Aedes aegypti*, *Anopheles stephensi*, and *Culex quinquefasciatus*. *Parasitology Research*, 110: 1841–1847.

Patrican, L.A. anf DeFoliart G.R. (1985). Lack of adverse effect of transovarially acquired La Crosse virus infection on the reproductive capacity of *Aedes triseriatus* (Diptera: Culicidae) *Journal of Medical Entomology*, 22: 604–611.

Paul, B., Paul, S. and Khan, M.A. (2011). A potential economical substrate for large-scale production of *Bacillus thuringiensis* var. *kurstaki* for caterpillar control. *Biocontrol Science and Technology*, 21: 1363–1368.

Pedersen, A., Dedes, J., Gauthier, D. and Van Frankenhuyzen, K. (1997). Sublethal effects of *Bacillus thuringiensis* on the spruce budworm, *Choristoneura fumiferana*. *Entomologia Experimentalis et Applicata*, 83: 253–262.

Pham, T.T.H., Brar, S.K., Tyagi, R.D. and Surampali, R.Y. (2010). Optimization of Fenton oxidation pre-treatment for *B. thuringiensis* – Based production of value added products from wastewater sludge. *Journal of Environmental Management*, 91: 1657-1664.

Picher, S., Drogui, P., Guay, R. and Blais, J.F. (2002). Wastewater sludge and pig manure used as culture media for bioleaching of metal sulphides. *Hydrometallurgy*, 65: 177–186.

Pimentel, D., Zuniga, R. and Morrison, D. (2005). Update on the environmental and economic costs associated with alien-invasive species in the United States. *Ecological Entomology*, 52: 273-288.

Pinero, J.C., Mau, R.F.L. and Vargas, R.I. (2009).Managing oriental fruit fly (Diptera: Tephritidae), with spinosad-based protein bait spraysand sanitation in papaya orchards in Hawaii. *Journal of Economic Entomology*, 102: 1123–1132.

Polanczyk, R.A. and Alves, S.B. (2005). Biological parameters of *Spodoptera frugiperda* (J.E. Smith) (Lepidoptera: Noctuidae) assayed with *Bacillus thuringiensis* Berliner. *Scientia Agricola*, 62: 464-468.

Ponce, A., Connon, A.S and Yung, P.T. *(2*008*). Detection and viability assessment of endospore-forming pathogens. In Principles of Bacterial Detection: Biosensors, Recognition Receptors and Microsystems, ed. M. Zourob, S. Elwary, and A. Turner, pp.* 481-*523. New York: Springer.*

Prutz, G. and Dettner, K. (2005). Effects of various concentrations of *Bacillus thuringiensis*-corn leaf material on food utilization by *Chilo partellus* larvae of different ages. *Phytoparasitica*, 33: 467-479.

Quinlan, R.J. and Gill, A. (2006). *The World Market for Microbial Biopesticides, Overview Volume*. Wallingford: CPL Business Consultants.

Rabiya, S.T. (2003). MALDI-TOF Mass Spectrometry: Getting a Feel for How It Works. *Oncology Times*, 25: 26.

Rahman, I. and Macnee, W. (2000). Regulation of redox glutathione levels and gene transcription in lung inflammation: therapeutic approaches. *Free Radical Biology and Medicine*, 28: 1405–1420.

Ranasinghe, C. and Akhurst, R. (2002). Matrix assisted laser desorption ionisation time of flight mass spectrometry (MALDI-TOF MS) for detecting novel Bt toxins. *Journal of Invertebrate Pathology*, 79: 51–58.

Raudales, R.E. and Gardener, B.B.M. (2008). ***Microbial Biopesticides for the Control of Plant Diseases in Organic Farming in Agriculture and Natural Resources***. The Ohio State University: Ohio..

Ravensberg, W.J. (2011). *A Roadmap to the Successful Development and Commercialization of Microbial Pest Control Products for Control of Arthropods (Progress in Biological Control)*. Dordrecht: Springer.

Raymond, B., Johnston, P.R., Nielsen-LeRoux, C., Lereclus, D. and Crickmore, N. (2010). *Bacillus thuringiensis*: an impotent pathogen?. *Trends in Microbiology*, 18: 189–194.

Renganathan, K., Rathinam, X., Danial, M. and Subramaniam, S. (2011). Quick isolation and characterization of novel *Bacillus thuringiensis* strains from mosquito breeding sites in Malaysia. *Emirates Journal of Food and Agriculture*. 23: 17-26.

Rharrabe, K., Amri, H., Bouayad, N. and Sayah, F. (2008). Effects of azadirachtin on post-embryonic development, energy reserves and (alpha-amylase activity of *Plodia interpunctella* Hubner (Lepidoptera: Pyralidae). *Journal of Stored Products Research*, 44: 290–294.

Rizvi, P.Q., Choudhury, R.A. and Ali, A. (2009). Recent Advances in Biopesticides. In *Microbial Strategies for Crop Improvement*, ed. M.S. Khan, A. Zaidi and J. Musarrat, pp. 185-203. India: Springer Berlin Heidelberg.

Roh, J.Y., Choi, J.Y., Li, M.S., Jin, B.R. and Je, Y.H. (2007). *Bacillus thuringiensis* as a specific, safe, and effective tool for insect pest control. *Journal of Microbiology and Biotechnology,* 17: 547-559.

Rota-Stabelli, O., Blaxter, M. and Anfora, G. (2013). Quick guide: *Drosophila suzukii*. *Current Biology*, 1: R8-R9.

Ruiu, L., Delrio, G., Ellar, D.J., Floris, I., Paglietti, B., Rubino, S. and Satta, A. (2006). Lethal and sublethal effects of Brevibacillus laterosporus on the housefly (*Musca domestica*). *Entomologia Experimentalis et Applicata*, 118: 137–144.

Ruiu, L., Satta, A. and Floris, I. (2017). Susceptibility of the house fly pupal parasitoid *Muscidifurax raptor* (Hymenoptera: Pteromalidae) to the entomopathogenic bacteria *Bacillus thuringiensis* and *Brevibacillus laterosporus. Biological Control,* 43: 188-194.

Ruiu, L., Satta, A. and Floris, I. (2012). Observations on house fly larvae midgut ultrastructure after *Brevibacillus laterosporus* ingestion. *Journal of Invertebrate Pathology,* 111: 211–216.

Ryerse, J.S., Beck, J.J.R. and Lavrik, P.B. (1990). Light microscope immunolocation of *Bacillus thuringiensis kurstaki* -endotoxin in the midgut and Malpighian tubules of the tobacco budworm, *Heliothis virescens*. *Journal of Invertebrate Pathology*. 56: 86-90.

Ryzhove, V., Hathout, Y. and Fenselau, C. (2000). Rapid characterisation of spores of *Bacillus cereus* group bacterias by matrix-assisted laser desorption/ionization time of-flight mass spectrometry. *Applied and Environmental Microbiology,* 66: 3828–3834.

Sabater, S., Guasch, H, Romani, A and Munoz, I. (2002). The effect of biological factors on the efficiency of river biofilms in improving water quality. *Hydrobiology*, 469: 1–3.

Saenz, A.J., Peterson, C.E., Valentine, N.B., Gantt, S., Jarman, K.H., Kingsley, M.T. and Wahl, K.L. (1999). Reproducibility of matrix-assisted laser desorbtion/ ionization time of flight mass spectrometry for replicate bacterial culture analysis. *Rapid Communications in Mass Spectrometry*, 13: 1580–1585.

Salma, M., Rajkhowa, R. and Kalita, J. (2011). A Review on use of Biopesticides in Insect Management. *International Journal of Science and Advanced Technology,* 1: 77-89.

Sanahuja, G., Banakar, R., Twyman, R.M., Capell, T. and Christou, P. (2011). *Bacillus thuringiensis*: a century of research, development and commercial applications. *Plant Biotechnology,* 9: 283–300.

Sanchis, V. and Bourguet, D. (2008). *Bacillus thuringiensis*: Applications in agriculture and insect resistance management, A review. *Agronomy for Sustainable Development,* 28: 11–20.

Sasaki, M. and Sato, R. (1995). Bionomics of the cherry drosophila, *Drosophila suzukii* Matsumura (Diptera: Drosophilidae) in Futeushima prefecture (Japan). *Annual Report of the Society of Plant Protection of North Japan*, 46: 164-172.

Schallmey, M., Singh, A. and Ward, O.P. (2004). Developments in the use of *Bacillus* species for industrial production. *Canadian Journal of Microbiology,* 50: 1–17.

Schneider, G. and Sprenger, G.A. (2008). Transaldolase B: trapping of Schiff base intermediate between dihydroxyacetone and ε-amino group of active-site lysine residue by borohydrin reduction. *Methods in Enzymology*, 354: 197–201.

Schnepf, E., Crickmore, N. and Van Rie, J. (1998). *Bacillus thuringiensis* and its pesticidal crystal proteins. *Microbiology and Molecular Biology Reviews*, 62: 775–806.

Schoonhoven, L.M., Jermy, T. and Van Loon, J.J.A. (1998). *Insect Plant Biology. From Physiology to Evolution*. London, UK: Chapman & Hall.

Schunemann, R., Knaak, N. and Fiuza, L. (2014). Mode of action and specificity of *Bacillus thuringiensis* toxins in the control of caterpillars and stink bugs in soybean culture. *ISRN Microbiology*, 2014: 1-12.

Seewooruthun, S.I., Permalloo, S., Sookar, P. and Soonnoo, A.R. (2000). The oriental fruit fly, *Bactrocera dorsalis* eradicated from Mauritius. In Proceedings of the Indian Ocean Commission, Regional Fruit Fly Symposium, ed. N.S. Price and I, Seewooruthun, pp. 207-210. Quatre Bornes, Mauritius: Indian Ocean Commission.

Setlow, P. (2001) Resistance of spores of *Bacillus* species to ultraviolet light. *Environmental and Molecular Mutagenesis*, 38: 97–104.

Setlow, P. (2003). Spore germination. *Current Opinion in Microbiology*, 6: 550–556.

Shang, Y.C., Leung, P. and Ling, B.H. (1998). Comparative economics of shrimp farming in Asia. *Aquaculture*, 164: 183–200.

Shojaaddini, M., Moharramipour, S., Khodabandeh, M. and Talebi, A. (2010). Development of a cost effective medium for production of *Bacillus thuringiensis* bioinsecticide using food barley. *Journal of Plant Protection Research*, 50: 9–14.

Singh, A., Khare, A. and Singh, A.P. (2012). Use of Vegetable Oils as Biopesticide in Grain Protection -A Review. *Journal of Biofertilizers & Biopesticides*, 3:114.

Singh, S.P., C.R. Balial and J. Poorani. (2002). Old bollworm *Helicoverpa armigera* associated Heliothine and their natural enemies In *Project Directorate of Biological Control*, pp. 135, Banglore, India: Tech. Bull. 31.

Smith, D.M., Burfod, M.A., Tabrett, S.J., Irvin, S. J. and Ward, L. (2002). The effect of feeding frequency on water quality and growth of the black tiger shrimp (*Penaeus monodon*). *Aquaculture* 207: 125–136.

Smitha, R.B., Jisha, V.N., Pradeep, S., Josh, M.S. and Benjamin, S. (2013). Potato flour mediated solid-state fermentation for the enhanced production of *Bacillus thuringiensis*-toxin. *Journal of Bioscience and Bioengineering*, 116: 595-601.

Soberon, M. Rodriguez-Almazan, C., Munoz-Garay, C., Parddo-Lopez, L., Porta, H. and Bravo, A. (2012). *Bacillus thuringiensis* Cry and Cyt mutants useful to counter toxin action in specific environments and to overcome insect resistance in the field. *Pesticide Biochemistry and Physiology,* 104: 111–117.

Soberon, M., Lopez-Diaz, J.A. and Bravo, A. (2013). Cyt toxins produced by *Bacillus thuringiensis*: A protein fold conserved in several pathogenic microorganisms. *Peptides*, 41: 87–93.

Song, F.P., Zhang, J., Gu, A.X., Wu, Y., Han, L.L., He, K.L., Chen, Z.Y., Yao, J., Hu, Y.Q., Li, G.X. and Huang, D.F. (2003). Identification of cry1I-type genes from *Bacillus thuringiensis* strains and characterization of a novel cry1I-type gene. *Applied and Environmental Microbiology*, 69 :5207–5211.

Sousa, M.E.C., Santos, F.A.B, Wanderley-Teixeira, V., Teixera, A.A.C., De Siqueira, H.A.A., Alves, L.C. and Torres, J.B. (2010). Histopathology and ultrastructure of midgut of *Alabama argillacea* (Hubner) (Lepidoptera: Noctuidae) fed Bt-cotton. *Journal of Insect Physiology, 56: 1913-1919.*

Souto, G.I., Correa, O.S., Montecchia, M.S., Kerber, N.L., Pucheu, N.L., Bachur, M. and Garcia, A.F. (2004). Genetic and functional characterization of a *Bacillus* sp. strain excreting surfactin and antifungal metabolites partially identified as iturin-like compounds. *Journal of Applied Microbiology* 97: 1247-1256.

Steck, G. J. (1999). Oriental Fruit Fly Facts. *Journal of Economic Entomology*, 93, 357-367.

Steck, G.J., *Pest Alert: A guava fruit-Bactrocera correcta* (Bezzi) (Tephritidae) for the Florida Department of Agriculture & Consumer Services. Entomology Circular: Florida. 2002.

Stephens, A.E.A., Kriticos, D.J. and Leriche, A. (2007). The current and future potential geographical distribution of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae). *Bulletin of Entomological Research*, 97: 369-378.

Su, Y., Mennerich, A. and Urban, B. (2012). Synergistic cooperation between wastewater-born algae and activated sludge for wastewater treatment: influence of algae and sludge inoculation ratios. *Bioresource Technology*, 105: 67–73.

Szewczyk, B., Rabalski, L., Krol, E., Sihler, W. and Lobo de Souza, M. (2009). Baculovirus biopesticides – a safe alternative to chemical protection of plants. *Journal of Biopesticides*, 2: 209–216.

Tang, M., Zeng, H.H. and Qin, L.T. (2014). Overview of pesticide toxicity studies on oblique scenedesmus. *Advanced Materials Research*, 1010: 1220-1224.

Tendencia, E.A. and Dela Pena, L.D. (2002). Level and percentage recovery of resistance to oxytetracycline and oxolinic acid of bacteria from shrimp ponds. *Aquculture*, 213: 1–13.

Tietze, N.S., Olson, M.A., Hester, P.G. and Moore, J.J. (1993). Tolerance of sewage treatment plant microorganisms to mosquitocides. *Journal of the American Mosquito Control Association*, 9: 477–479.

Tirado-Montiel, M.L., Tyagi, R.D. and Valero, J.R. (2001). Wastewater treatment sludge as a raw material for the production of *Bacillus thuringiensis* based biopesticides. *Water Research* 35: 3807–3816.

Tirado-Montiel, M.T.L., Tyagi, R.D. and Valero, J.R. (1998). Production of *Bacillus thuringiensis* using waste materials. In *Bioconversion of waste amterials to industrial products*, ed. A.M. Martin, pp. 480-516. London, UK: Blackie Academic Press & Professionnal.

Todar, K. (2012). *The Growth of Bacterial Populations, PhD Textbook of Bacteriology*. Madison: Wisconsin.

Trejo, A., de-Bashan, L.E., Hartmann, A., Hernandez, J., Rothballer, M., Schmid, M. and Bashan, Y. (2012). Recycling waste debris of immobilized microalgae and plant growth-promoting bacteria from wastewater treatment as a resource to improve fertility of eroded desert soil. *Environmental and Experimental Botany*, 75: 65-73.

Tyagi, R.K., Babu, B.R. and Datta, K. (2005). Simultaneous determination of native and subunit molecular weights of proteins by pore limit electrophoresis and restricted use of sodium dodecyl sulfate. *Electrophoresis*, 14: 826-828.

Tyrell, D.J., Lee, A., Bulla, J.R. and Davidson, L.I. (1981). Characterization of dpore coat proteins of *Bacillus thuringiensis* and *Bacillus cereus*. *Comparative Biochemistry and Physiology*, 70B: 535-539.

U.S. EPA, U.S. (2012) .Environmental Protection Agency*. In Guidelines for Water Reuse. EPA/600/R–12/618. pp. 54-56.*

United States Environmental Protection Agency*. Guidelines for water reuse 2012*; CDM Smith Inc.: Washington, 2012.

Usta, C. (2013). Microorganisms in Biological Pest Control — A Review (Bacterial Toxin Application and Effect of Environmental Factors) In *Agricultural and Biological Sciences. Current Progress in Biological Research*. ed. Silva, M. pp 234-267. CC By: Canada.

Van der Werf H.M.G. (1996). Assessing the impact of pesticides on the environment. Agriculture. *Ecosystems* & *Environment* 60: 81–96.

Van Rie, J., McGaughey, W.H., Johnson, D.E., Barnett, B.D. and van Mellaert, H. (1990). Mechanism of insect resistance to the microbial insecticide *Bacillus thuringiensis*. *Science*, 247: 72-74.

Van Rie, J., Van Mellaert, H., and Peferoen, M. (1992). Mechanism of insect resistance to *Bacillus thuringiensis* in *Plodia interpunctella* and *Plutella xylostella*. In *Molecular mechanisms of insecticide resistance: diversity among insects*, ed. C.A. Mullin and J.G. Scott. pp. 567-580. Washington, DC: American Chemical Society.

Vargas, R.I., Leblanc, L., Putoa, R. and Eitam, A. (2007). Impact of introduction of *Bactrocera dorsalis* (Diptera: Tephritidae) and classical biological control releases of *Fopius arisanus* (Hymenoptera: Braconidae) on economically important fruit flies in French Polynesia. *Journal of Economic Entomology*, 100: 670-679.

Verghese, A., Tandon, P.L. and Stonehouse, J.M. (2004). Economic evaluation of the integrated management of the oriental fruit fly, *Bactrocera dorsalis* (Diptera: Tephritidae) in mango in India. *Crop Protection*, 23: 61–63.

Verma, M., Brar, S.K., Riopel, A.R., Tyagi, R.D. and Surampalli, R.Y. (2007). Pre-treatment of wastewater sludge-biodegradability and Rheology study. *Environmental Technology* 28: 273–284.

Vettori, C., Paffetti, D., Saxena, D., Stotzky, G. and Giannini, R. (2003) Persistence of toxins and cells of *Bacillus thuringiensis subsp. kurstaki* introduced in sprays to Sardinia soils. *Soil Biology* & *Biochemistry* 35: 1635–1642.

Vidyarthi, A. S., Tyagi, R. D., Valéro, J. R., & Surampalli, R. Y. (2002). Studies on the production of *Bacillus thuringiensis* based biopesticides using wastewater sludge as a raw material. *Water Research*, 36, 4850–4860.

Vimala Devi, P.S., Ravinder, T. and Jaidev, C. (2005). Cost-effective production of *Bacillus thuringiensis* by solid state fermentation. *Journal of Invertebrate Pathology*, 88: 163–168.

Vu, K.D., Tyagi, R.D., Surampalli R.Y., and Valero, J.R. (2012) Mathematical relationships between spore concentrations, delta-endotoxin levels, and entomotoxicity of *Bacillus thuringiensis* preparations produced in different fermentation media. *Bioresource Technology,* 123: 303-311.

Vu, K.D., Tyagi, R.D., Valero, J.R. and Surampalli, R.Y. (2010). Batch and fed-batch fermentation of *Bacillus thuringiensis* using starch industry wastewater as fermentation substrate*. Bioprocess and Biosystems Engineering*, 33: 691-700.

Vuolanto, A., Von Weymarn, N., Kerovuo, J., Ojamo, H. and Leisola, M. (2001). Phytase production by high cell density culture of recombinant *Bacillus subtilis*. *Biotechnology Letters*, 23: 761–766.

Walsh, D.B., Bolda, M.P., Goodhue, R.E., Dreeves, A.J., Lee, J.C., Bruck, D.J., Walton, V.M., O'Neal, S.D. and Zalom, F.G. (2011). *Drosophila suzukii* (Diptera: Drosophilidae): Invasive pest of ripening soft fruit expanding its geographic range and damage potential. *Journal of Integrated Pest Management*, 1: 1–7.

Wan, N., Ji, X., Jiang, J., Qiao, H. and Huang, K. (2013). A methodological approach to assess the combined reduction of chemical pesticides and chemical fertilizers for low-carbon agriculture. *Ecological Indicators* 24: 344–352.

Wang, Y., Oberley, L.W. and Murhammer, D.W. (2001). Evidence of oxidative stress following the viral infection of two Lepidopteran insect cell lines. *Free Radical Biology* and *Medicine*, 31: 1448–1455.

Wang, Y.B. and Han, J.Z. (2007). The role of probiotic cell wall hydrophobicity in bioremediation of aquaculture. *Aquaculture*, 269: 349–354.

Wang, Z., Russon, L., Roser, D.C. and Long, S.R. (1998). Investigation of spectral reproducibility in direct analysis of bacterial proteins by matrix-assisted laser desorption/ionization time of-flight mass spectrometry. *Rapid Communications in Mass Spectrometry*, 12: 456–464.

Wang-Lee, Y. and Zairi, J. (Eds.). (2005). Proceedings of the Fifth International Conference on Urban Pests: Effects of sublethal dose of *Bacillus thuringiensis H-14* exposure on *Aedes albopictus (Diptera: Culicidae)*.

Waterhouse, D. F. (1997). The major invertebrate pests and weeds of agriculture and plantation forestry in the Southern and Sestern Pacific. In *ACIAR Monograph 44*. Canberra, Australia: Australian Center for International Agricultural Research.

Whalon, M.E. and McGaughey, W.H. (1998). *Bacillus thuringiensis*: Use and Resistance management. In *Insecticides with novel modes of action: mechanism and application*, ed. I. Ishaaya and D. Degheele, pp. 106-137. Berlin: Springer.

Whalon, M.E. and Wingerd, B.A. (2003). Bt: mode of action and use. *Archives of Insect Biochemistry* and *Physiology*, 54: 200–211.

White, P.J. and Lotay, H.K. (1980). Minimal nutritional requirements of *Bacillus sphaericus* NCTC9602 and 26 other strains of this species: the majority grow and sporulate with acetate as sole major source of carbon. *Journal of General Microbiology*, 118: 13–19.

Wolken, W.A.M., Tramper, J. and van der derf, M.J. (2003). What spores can do for us. *Trends in Biotechnology*, 21: 338-345.

Won, S.Y., Munoz-Price, L.S., Lolans, K., Hota, B., Weinstein, R.A. and Hayden, M.K. (2011). Emergence and Rapid Regional Spread of *Klebsiella pneumoniae* Carbapenemase-Producing Enterobacteriaceae. *Clinical Infectious Diseases*. 53: 532-540.

Wozniak, C.A. and Martinez, J.C. (2011). U.S. EPA Regulation of Plant-Incorporated Protectants: Assessment of Impacts of Gene Flow from Pest-Resistant Plants*. Journal of Agricultural and Food Chemistry*, 59: 5859–5864.

Wu, D., Yuan, Y., Liu, P., Wu, Y. and Gao, M. (2014). Cellular responses in *Bacillus thuringiensis* CS33 during bacteriophage BtCS33 infection. *Journal of Proteomics*, 101: 192-204.

Yan, S., Mohammedi, S., Tyagi, R.D., Surampalli, R.Y. and Valero, J.R. (2007). Growth of four serovar of *Bacillus thuringiensis* (var. kurstaki, israelensis, tenebrionis, and aizawai) in wastewater sludge. *Practice Periodical of Hazardous, Toxic, and Radioactive Waste Management*, 11: 123–129.

Yezza, A., Tyagi, R.D., Vale´ro, J.R. and Surampalli, R.Y. (2004). Production of *Bacillus thuringiensis* based biopesticides in batch and fed-batch cultures using wastewater sludge as a raw material. *Journal* of Chemical *Technology and Biotechnology,* 80: 502–10.

Yezza, A., Tyagi, R.D., Valero, J.R. and Surampalli, R.Y. (2006). Bioconversion of industrial wastewater and wastewater sludge into *Bacillus thuringiensis* based biopesticides in pilot fermentor. *Bioresource Technology,* 97: 1850–1857.

Yezza, A., Tyazi, R. D., Valero, J. R., & Surampalli, R. Y. (2005). Wastewater sludge pre treatment for enhancing entomotoxicity produced by *Bacillus thuringiensis var. kurataki*. *World Journal of Microbiology and Biotechnology*, 21, 1165–1174.

Zhang, X., Yan, S., Tyagi, R.D., Surampalli, R. and Valero, J.R. (2014). Wastewater sludge as raw material for microbial oils production. *Applied Energy*, 135: 192–201.

Zhao, Y.Q., Zhaou, X.H. and Babatunde, A.O. (2009). Use of dewatered alum sludge as main substrate in treatment reed bed receiving agricultural wastewater: long-term trial. *Bioresource Technology*, 100: 644–648.

Zhong, C., Ellar, D.J., Bishop, A., Johnson, C., Lin, S. and Hart, E.R. (2000). Characterization of a *Bacillus thuringiensis* delta-endotoxin which is toxic to insects in three orders. *Journal of Invertebrate Pathology*, 76: 131–139.

Zhouri, N., Achour, O. and Jaoua, S. (2002). Production of delta-endotoxin by *Bacillus thuringiensis* subsp. *kurstaki* and over-coming of catabolite repression by using highly concentrated gruel and fish meal media in 2 and 20 dm3 fermentors. *Journal of Chemical Technology and Biotechnology* 77: 877-882.

Zhu, L., Li, M., Wei, L., Liu, X., Yin, J. and Gao, Y. (2014). Fast fixing and comprehensive identification to help improve real-time ligands discovery based on formaldehyde crosslinking, immunoprecipitation and SDS-PAGE separation. *Proteome Science*, **12**: 6.

Zhu, Y.C., Kramer, K.J., Oppert, B. and Dowdy, A.K. (2000). cDNAs of aminopeptidase-like protein genes from *Plodia interpunctella* strains with different susceptibilities to *Bacillus thuringiensis* toxins. *Insect Biochemistry* and *Molecular Biology*, 30: 215–224.

Zhuang, L., Zhou, S., Wang, Y. and Chang, M. (2010). Mosquito biolarvicide production by sequential fermentation with dual strains of *Bacillus thuringiensis subsp. israelensis* and *Bacillus sphaericus* using sewage sludge. *Bioresource Technology* 102:1574-1580.

Zhuang, L., Zhou, S., Wang, Y. and Chang, M. (2011). Mosquito biolarvicide production by sequential fermentation with dual strains of *Bacillus thuringiensis subsp. israelensis* and *Bacillus sphaericus* using sewage sludge. *Bioresource Technology* 102: 1574–1580.

Zouari, N. and Jaoua, S. (1999). The effect of complex carbon and nitrogen, salt, Tween-80 and acetate on delta-endotoxin production by a *Bacillus thuringiensis* subsp *kurstaki*. *Journal of Industrial Microbiology and Biotechnology*, 23: 497–502.

Zubair, A., Lim, B.R., Cho, J. and Ahn, K.H. (2006). Effects of the internal recycling rate on biological nutrient removal and microbial community structure in a sequential anoxic/anaerobic membrane bioreactor. *Bioprocess and Biosystems Engineering,* 30: 61-69.