



UNIVERSITI PUTRA MALAYSIA

**A STUDY ON THE GROWTH AND BIOCHEMICAL RESPONSES IN
SELECTED CROPS TO ELECTROMAGNETIC FIELD**

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FSAS 2003 28

**A STUDY ON THE GROWTH AND BIOCHEMICAL RESPONSES IN
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By

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

July 2003



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

**A STUDY ON THE GROWTH AND BIOCHEMICAL RESPONSES IN
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July 2003

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Faculty : Science and Environmental Studies

Electromagnetic field (EMF), a non-ionizing radiation exists in abundant in the vicinity of high voltage power lines, which covers a large area of the agricultural land. The study on the effects of EMF on biological system has been rare in the country; therefore, the study on the growth and biochemical responses of plants to EMF would provide new and important knowledge to the agricultural industry.

The study was divided into three parts, namely the effects of high electric field on *Oncidium tuka* PLBs, the effects of high electric field as a seed treatment on soybean, radish and papaya, and the effects of EMF from electric power lines on leaf mustard and oil palm. The high electric field strength used in the study was 0, 10, 20, 40, 60, 80, 100 and 120 kV/m. The biochemical changes in leaf mustard planted at 0, 3, 6, 9, 10, 12, 15, 18, 20, 21, 30, 40, 50 and 60 m away from the 33 kV power line

and at 0, 10, 20, 30, 40, 50, 60 and 70 m away from the 275 kV power lines were studied. The effects of EMF from 275 kV power lines were also studied on seven years old oil palm trees which were exposed to EMF for that period and six months old oil palm trees which were exposed to EMF for that period of time a distance of 0, 8.8, 17.6, 26.4, 35.2, 44, 52.8 and 61.6 m away from the lines.

The study of high electric field on *O. taka* PLBs showed the potential of using electric field as a tool to increase and manipulate the growth of *in vitro* *O. taka* as a one-hour treatment with 40 kV/m was found to significantly ($p < 0.05$) increase the growth rate and chlorophyll content of the *O. taka* plantlets. The study on the effects of high electric field seed treatment on germinating soybean seeds showed increased germination rate at 10, 60 and 100 kV/m, while increased germination rate for radish and papaya were obtained from treatment 100 and 60 kV/m, respectively. High electric field treatment on germinating seeds also resulted in increased seedling growth of soybean, radish and papaya with 60 kV/m resulting in increased growth in all three of the crops.

The effects of EMF from 33 kV power lines on leaf mustard planted at different distances from the line showed that leaf mustard planted within 20 m from the line had significantly ($p < 0.05$) higher protein, soluble nitrogen and chlorophyll content due to the higher EMF strength which decrease with increasing distance from the line. Higher EMF strength nearer to the 275 kV power line resulted in higher

peroxidase enzyme activity and chlorophyll content in leaf mustard. Protein electrophoretic profile obtained from SDS PAGE revealed no drastic genetic alteration in the leaf mustard.

The peroxidase enzyme activity of oil palm directly below the 275 kV power line was significantly ($p < 0.05$) higher and decreased with decreasing EMF strength signifying that EMF exposure on oil palm for a duration of both seven years and six months resulted in a stress related response. Higher peroxidase enzyme activity staining intensity was also obtained in those planted nearer to the power line.

The study has paved the way for more studies to be done on the effects of EMF on plants where it has shown its potential to be used as a novel tool to stimulate plant growth via tissue culture methods or as a seed treatment. The study has shown that EMF does have an effect on plants, where biochemical changes takes place in response to the non-ionizing radiation.

Abstrak tesis yang dikemukakan kepada Senat Universiti Putra Malaysia sebagai memenuhi keperluan untuk ijazah Master Sains

**KAJIAN KE ATAS PERTUMBUHAN DAN TINDAKBALAS BIOKIMIA
BEBERAPA TANAMAN TERPILIH TERHADAP MEDAN
ELEKTROMAGNETIK**

Oleh

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Medan elektromagnetik ialah suatu radiasi tidak mengion yang wujud dengan banyak terutamanya di kawasan yang berdekatan dengan talian elektrik voltan tinggi yang merangkai kawasan pertanian yang luas. Kajian ke atas kesan medan elektromagnetik ke atas sistem kehidupan adalah jarang dalam negara ini, oleh itu, kajian tentang tindakbalas pertumbuhan dan biokimia tanaman terhadap medan elektromagnetik akan menyumbang kepada penemuan pengetahuan baru yang penting kepada industri pertanian.

Kajian kesan medan elektromagnetik ke atas beberapa jenis tanaman telah dibahagikan kepada tiga bahagian, iaitu, kesan medan elektrik tinggi ke atas protokom *Oncidium tuka*, kesan medan elektrik tinggi sebagai rawatan benih ke atas kacang soya, lobak putih dan betik, dan kesan elektromagnetik dari talian elektrik ke atas tanaman sawi dan kelapa sawit. Kekuatan medan elektrik tinggi yang dikaji ialah 0, 10, 20, 40, 60, 80, 100 dan 120 kV/m. Perubahan biokimia dalam tanaman sawi pada jarak 0, 3, 6, 9, 10, 12, 15, 18, 20, 21, 30, 40, 50 and 60 m dari talian elektrik

muatan 33 kV dan pada jarak 0, 10, 20, 30, 40, 50, 60 and 70 m dari talian elektrik muatan 275 kV telah dikaji. Kesan medan elektromagnetik dari talian elektrik muatan 275 kV juga dikaji pada tanaman kelapa sawit yang di tanam di bawah pengaruh medan elektromagnetik selama tujuh tahun dan juga tanaman kelapa sawit yang terdedah kepada medan elektromagnetik selama enam bulan, masing-masing pada jarak 0, 8.8, 17.6, 26.4, 35.2, 44, 52.8 and 61.6 m dari talian elektrik tersebut.

Kajian medan elektrik tinggi ke atas protokom *O. taka* PLBs telah menunjukkan potensi penggunaan medan elektrik sebagai suatu cara untuk meningkatkan dan mengawal pertumbuhan *O. taka in vitro* kerana rawatan 40 kV/m selama satu jam telah berjaya untuk meningkatkan kadar pertumbuhan dan kandungan klorofil secara signifikan ($p < 0.05$). Medan elektrik tinggi sebagai rawatan benih ke atas kacang soya telah didapati meningkatkan kadar percambahan dengan penggunaan kekuatan medan elektrik sebanyak 10, 60 and 100 kV/m, manakala peningkatan kadar percambahan lobak putih telah didapati dengan 100 kV/m dan kekuatan medan elektrik 60 kV/m telah meningkatkan kadar percambahan benih betik. Selain daripada peningkatan percambahan benih, rawatan benih dengan medan elektrik juga telah mengakibatkan peningkatan pertumbuhan anak benih kacang soya, lobak putih dan betik khasnya kekuatan medan elektrik 60 kV/m yang telah merangsangkan kadar pertumbuhan anak benih ketiga-tiga jenis tanaman tersebut.

Kesan medan elektromagnetik dari talian elektrik 33 kV pada tanaman sawi menunjukkan bahawa sawi yang di tanam dalam lingkungan jarak 20 m dari talian tersebut mempunyai kandungan protein, nitrogen terlarut dan klorofil yang lebih

tinggi akibat kekuatan medan elektromagnetik yang tinggi. Kekuatan medan elektromagnetik menurun dengan meningkatnya jarak dari talian elektrik. Aktiviti enzim peroksidase dan kandungan klorofil yang lebih tinggi juga didapati pada sawi yang ditanam pada jarak yang berdekatan dengan talian elektrik muatan 275 kV. Profil protein elektroforesis yang didapati dari SDS PAGE telah menunjukkan tiada perbezaan yang ketara pada tanaman sawi yang menerima kekuatan medan elektromagnetik yang berbeza.

Aktiviti enzim peroksidase pada tanaman kelapa sawit yang ditanam di bawah talian elektrik 275 kV adalah lebih tinggi dan aktiviti enzim ini menurun dengan menurunnya kekuatan medan elektromagnetik pada jarak yang lebih jauh. Ini menunjukkan bahawa kesan medan elektromagnetik kepada kelapa sawit selama tujuh tahun ataupun enam bulan telah menyebabkan suatu tindak balas yang merupai tindak balas tanaman terhadap tekanan. Pewarnaan profil aktiviti peroksidase dari elektroforesis yang lebih ketara juga didapati pada kelapa sawit yang ditanam pada jarak yang lebih dekat kepada talian elektrik.

Kajian ini telah meninjau kesan medan elektromagnetik ke atas tanaman dan menunjukkan potensi penggunaan medan elektromagnetik sebagai suatu cara baru untuk mengalakkan pertumbuhan tanaman melalui cara tisu kultur ataupun dengan cara rawatan benih. Kajian ini telah berjaya untuk menunjukkan bahawa terdapat kesan medan elektromagnetik ke atas tanaman, di mana perubahan biokimia berlaku di dalam tanaman sebagai cara tindak balas terhadap medan elektromagnetik yang dikesannya.

ACKNOWLEDGEMENT

The author would like to express her heartfelt gratitude to Professor Dr. Marziah Mahmood as the main supervisor of this project for her wisdom, advice, guidance, encouragement, constructive criticisms, kind generosity and understanding throughout the project. She has been a great source of inspiration and motivation to the author. Sincere and heartfelt gratitude also goes out to the committee members of this project, Associate Professor Dr. Mahmud Tengku Muda Mohamed and Associate Professor Dr. Siti Khalijah Daud. The author is also grateful to Dr. Mohd Puad Abdullah, the chairman of the examination committee for her thesis evaluation.

A special dedication goes out to Associate Professor Dr. Mahmud Tengku Muda Mohamed who has been a great source of inspiration and motivation to the author. His unconditional generosity, kindness, encouragement, understanding, advice and strong support have been instrumental to the academic and personal development of the author.

The author would also like to thank Professor Dr. Ahmad Darus from Universiti Teknologi Malaysia for his guidance and use of the High Voltage Lab during the course of this study. Special thanks and appreciation also goes out to Tenaga Nasional Berhad Research for initiating and funding this project. Heartfelt gratitude also goes out to the Ministry of Science, Technology and Environment for the National Science Fellowship.



The author is thankful for the friendship shared with all the fellow students and ex-students from the Phytotech Lab, namely Tee Chong Siang, Wee Chien Yeong, Sreeramanan, Anna Ling, Sobri Hussein, Suzita Sulaiman, Rosli, Zuraida, Dr. Janna, Dr. Iteu, Deswina, Ramani, Dr. Azlan Jualang Gansau, Dr. Aziz Ahmad and all the staff in the Department of Biochemistry. The author is grateful for their help and cooperation throughout the ongoing of her project.

The author's greatest gratitude and love goes out to her very dear family, Pa, Ma, James and Josephine for their unconditional love, care and understanding. Last but not least, to a very special person, Yeap Boon Seah for his love, patience and support.



I certify that an Examination Committee met on 11 July 2003 to conduct the final examination of Ooi Bee Bee on her Master of Science thesis entitled "A Study on the Growth and Biochemical Responses in Selected Crops to Electromagnetic Field" in accordance with Universiti Pertanian Malaysia (Higher Degree) Act 1980 and Universiti Pertanian Malaysia (Higher Degree) Regulation 1981. The Committee recommends that the candidate be awarded the relevant degree. Members of the Examination Committee are as follows:

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DECLARATION

I hereby declare that the thesis is based on my original work except for quotations and citations which have been duly acknowledged. I also declare that it has not been previously or concurrently submitted for any other degree at UPM or other institutions.



OOI BEE BEE

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