ALLELOPATHIC POTENTIAL OF ESSENTIAL OILS ISOLATED FROM LOCAL PLANTS ON COMMON WEEDS FOUND IN MALAYSIAN CROPLANDS

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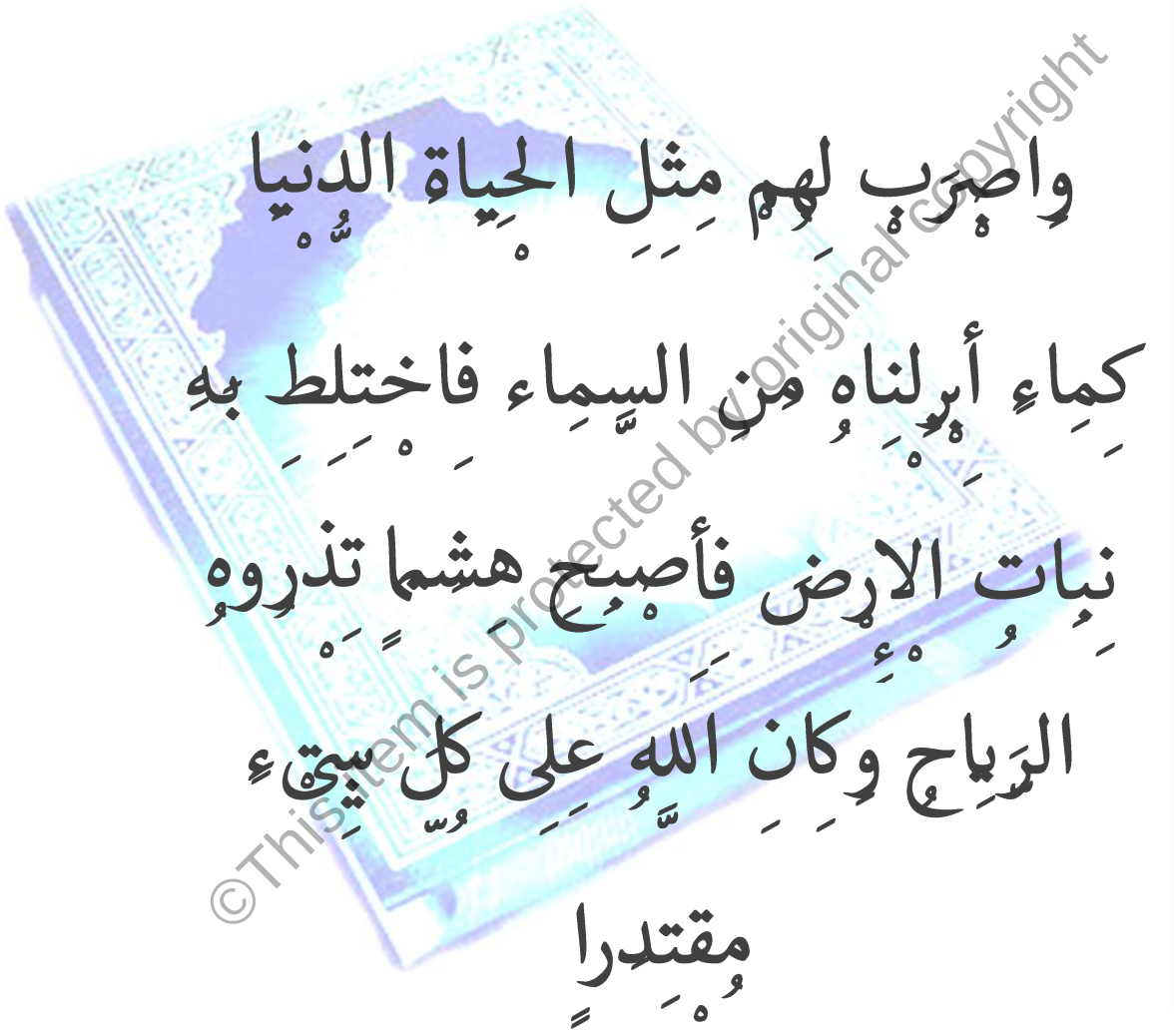

وَاضْرِبْ لَهُم مَّثَلَ الْحَيَاةِ الدُّنْيَا
كَمَاءٍ أَنزَلْنَاهُ مِنَ السَّمَاءِ فَاخْتَلَطَ بِهِ
نَبَاتُ الْأَرْضِ فَأَصْبَحَ هَشِيمًا تَذْرُوهُ
الرِّيَاحُ وَكَانَ اللَّهُ عَلَىٰ كُلِّ شَيْءٍ
مُّقْتَدِرًا

Surah al kahf; verse (45)

To the scent of paradise and my life's light

My father and my mother

To my soul, who ever gave me encouragement to get higher ideas of my life

My wife MUNA

To the smiling face of my life

My beloved kids

ABDULLAH & ALI

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Ahmed Abdulwahid Ali Almarie

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LIST OF ABBREVIATIONS

ALS	Acetolactate synthase
ANOVA	Analysis of variance
CEAS Tech	Center of Excellence for Advanced Sensor Technology
CRD	Completely Randomized Design
DAS	Date after sowing
DAT	Days after treatment
DMSO	Dimethyl sulfoxide
DOXP	Deoxy-D-xylulose 5-phosphate pathway
ds. m^{-1}	Decisiemens per meter
EC	Electrical conductivity
INSAT	Institute of Sustainable Agriculture Tech.
FAO	Food and Agriculture organization
FID	Flame Ionization Detector
GC	Gas Chromatography
H130	Halexone 130
MS	Mass Spectrophotometer
MEP	Mevalonic acid pathway
OH^-	Hydroxyl
OM	Organic Matter
pH	Potential hydrogen
RCBD	Complete Block Design Organic matter
REL	Relative Electrolyte Leakage
SAS	Statistical Analysis System software
SDL	Sodium Dodecyl Sulphate
SEM	Scanning Electron Microscope
SPAD	Soil Plant Analysis Development
TTC	Triphenyl tetrazolium chloride
UniMAP	Universiti Malaysia Perlis

WHO	World Health Organization

LIST OF SYMBOLS

cm	Centimeter
g	gram
ha	hectare =10000 m^2
id	Interior diameter
M^2	Square meter
ml	Milliliter
mm	Millimeter
µm	Micrometer
µl	Microliter
Nm	Nanometer
%	Percentage
v/v	Volume per volume

w/w Weight per weight

Potensi allelopatik minyak pati yang diasingkan dari tumbuh-tumbuhan yang biasa ditemui dalam kawasan tanaman di Malaysia

ABSTRAK

Penggunaan racun rumpai sintetik secara berterusan untuk mengawal rumpai dalam pengeluaran pertanian boleh memberi kesan buruk kepada alam sekitar dan ekosistem, seterusnya mewujudkan kebimbangan keselamatan dan kesihatan kepada pengendali, pengguna dan komuniti. Walau bagaimanapun, pembangunan rintangan dalam sifat rumpai terhadap racun sintetik dan kesan nya telah memberi justifikasi kukuh ke atas keperluan menghasilkan racun rumpai alternatif mesra alam, semulajadi dan berisiko rendah tetapi berkesan. Kajian ini meneroka potensi allelopathik tumbuhan yang ditunjukkan dalam minyak patinya untuk digunakan sebagai racun alternatif berasaskan bio. Penyelidikan ini melibatkan pengasingan minyak pati dairpada lapan spesies tumbuhan terpilih iaitu *Cupurssus macrocarpa* Hartweg. (Goldcrest), *Melaleuca bracteates* F. Muell. (Tea tree), *Plectranthus amboinicus* (Lour.) Spreng (Bangun-bangun), *Cymbopogon nardus* L. (Lemongrass), *Pelargonium radula* Cav. (Jeremin), *Baeckea frutescens* L. (Cucur atap), *Murraya koenigii* L. (Pokok kari) dan *Persicaria odorata* (Lour.) Sojak (Pokok Kesum) melalui proses penyulingan wap. Minyak pati yang diasingkan disaring aktiviti herbisida nya sebagai pra kemunculan dengan menggunakan tiga kepakatan ke atas dua jenis rumpai utama (masing-masing 2 jenis rumpai berdaun dan rumpai daun lebar) yang di tanam secara biocerakin makmal dan dalam pot kultur. Sebatian minyak pati tersebut diciri menggunakan GC-MS. Kesan fitotosik lapan minyak pati juga dinilai sebagai paska kemunculan ke atas empat rumpai dengan menganalisa jumlah kandungan klorofil, kebocoran elektrolit relatif, pernafasan sel dan mekanisme stomata dalam membran daun. Minyak pati yang paling berkesan kemudiannya dinilai sebagai paska kemunculan terhadap rumpai yang terdapat di lapangan dengan aplikasi secara tunggal dan kombinasi dua minyak pati dan dibandingkan dengan racun sintetik Halexone (H130), sebagai kawalan. Minyak pati yang terbaik dipilih berdasarkan keberkesanan lebih daripada 70% perencatan. Keputusan menunjukkan bahawa minyak pati yang diasingkan daripada *C. macrocarpa*, *C. nardus* dan *P. radula* adalah yang paling berkesan dalam menghalang percambahan benih dan pertumbuhan anak benih sepenuhnya dalam biocerakin makmal dan kerosakan yang teruk ke atas rumpai yang tanam dalam pot. Berdasarkan analisis GC-MS, monoterpena adalah komponen yang paling dominan dan berkesan dalam semua minyak pati, diikuti oleh sesquiterpena dan phenylpropanoid. Ujikaji fitotosik menunjukkan bahawa jumlah kandungan klorofil, kebocoran elektrolit relatif dan pernafasan sel dipengaruhi secara ketara dengan penggunaan racun berasas bio. Kesan meningkat dengan meningkatnya kepekatan minyak pati. Minyak pati didapati menunjukan pengaruh yang ketara ke atas membran tumbuhan yang mempengaruhi mekanisme stomata, memecahkan membran sel dan pelarutan kandungannya yang akhirnya membunuh rumpai. Penggunaan minyak pati sebagai racun sentuh berasaskan bio diaplikasikan dalam bentuk pasca kemunculan kepada rumpai yang ditanam di

lapangan menunjukkan kesan yang setanding dengan racun sintetik konvensional H130. Penggunaan minyak pati yang dirumus dalam kombinasi dapat meningkatkan kesan fitotosik berbanding aplikasi mintak secara individu. Kombinasi *C. macrocarpa* dan *P. radula* masing-masing pada kepekatan 5% menunjukan kesan fitotosik terbaik dalam menindas populasi rumpai.

Allelopathic potential of essential oils isolated from local plants on common weeds found in Malaysian croplands

ABSTRACT

Continuous use of the synthetic herbicides to control weeds in agricultural production can have an adverse impact on the environment and the ecosystems creating safety and health concerns to the operators, consumers and the community. However, it is the resistance to the synthetic herbicides that developed in the targeted weeds and its consequent that provide strong justification for the need to develop an eco-friendly, natural and low risk but effective alternative bioherbicides. The study thus explores the benefits of using plant's allelopathic potential that manifested in its essential oil, as an alternative herbicide. The research involved the isolation of the essential oils from eight selected plant species of *Cupressus macrocarpa* Hartweg. (Goldcrest), *Melaleuca bracteata* F. Muell. (Tea tree), *Plectranthus amboinicus* (Lour.) Spreng (Spanish thyme), *Cymbopogon nardus L.* (Lemongrass), *Pelargonium radula Cav*. (Radula geranium), *Baeckea frutescens* L. (Cucur atap), *Murraya koenigii* L. (Curry tree) *and Persicaria odorata* (Lour.) Sojak (Kesum plant) by steam distillation. Isolated essential oils were screened for their herbicidal activity as preemergence applied at three concentrations on two major weed types (2 grassy and 2 broad leaves weed species) grown under bioassay laboratory and pot culture conditions. The compounds were characterized using GC-MS. The phytotoxic effects of the eight essential oils were also evaluated on the four weeds as postemergence by analyzing the total chlorophyll content, relative electrolyte leakage, cellular respiration and stomata mechanism in the leaf membrane. The most effective essential oils were then evaluated as postemergence by applying singly and in a combination of two essential oils on widely known weed grown in the open field and compared with the known synthetic herbicide, Halexone (H130) as a control. The best essential oils were selected based on their efficacy of more than 70 % inhibition. The results showed that the oils isolated from *C. macrocarpa, C. nardus* and *P. radula* were the most effective in inhibiting seed germination and seedling growth completely in laboratory bioassay and caused the most severe effects on weeds grown under the pot culture. GC-MS analysis showed monoterpene was the most dominant and effective component of all essential oils followed by sesquiterpene and phenylpropanoids. The phytotoxic experiment showed total chlorophyll content, relative electrolyte leakage and cellular respiration were significantly affected by the application of the bioherbicides. The effects increased by increasing the oil

concentration. There was a significant influence of the essential oils on plant membranes affecting the stomata mechanism, rupturing cell membrane, dissolution of its contents which eventually kill the weeds. The application of essential oils as postemergence herbicides to weed grown in the open field showed desirable efficiency against the weeds as non-selected contact bioherbicides comparable with the performance of the conventional synthetic herbicides H130. Application of the essential oils formulated in combinations improved the phytotoxic effects as compared to using oils singly. The combination of *C. macrocarpa* and *P. radula* at 5% each proved to produce the best phytotoxic effects in suppressing weed population.