UNIVERSITI PUTRA MALAYSIA

INFLUENCE OF PHYSICAL SPRAY CHARACTERISTICS AND PRESENCE OF GLYPHOSATE IN ENHANCING THE PERFORMANCE OF METSULFURON-METHYL AGAINST WOODY BORRERIA (DIODIA OCIMIFOLIA)

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By

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Thesis Submitted in Fulfillment of the Requirements for the Degree of Master of Agricultural Science in the Faculty of Agriculture, Universiti Putra Malaysia

January 1999

Dedicated to :

My father and mother,

wife and daughter,

brother and sisters

and friends

Thank you and I love you all

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LIST OF ABBREVIATIONS

m^2	= Square metre
%	= Percentage
cm	= Centimetre
kg	= Kilogram
a.i	=Active ingredient
L	= Litre
ha	= Hectare
μm	= Micrometre
m	= Metre
h	= Hour
μl	= Microlitre
°C	= Degree centigrade
w/v	= Weight per volume
v/v	= Volume per volume
DAS	= Days after spraying
WAA	= Weeks after application
w/w	= Weight over weight
ID	= Inhibitory dosage

Abstract of thesis submitted to the Senate of Universiti Putra Malaysia in fulfillment of the requirements for the degree of Master of Agricultural Science

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by

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January 1999

Chairman : Associate Prof. Dr Rajan Amartalingam

Faculty : Agriculture

Influence of physical spray characteristics (carrier volume, herbicide dosage and surfactant) and presence of glyphosate on the performance of metsulfuron-methyl against woody borreria (*Diodia ocimifolia*) was studied in the glass house. The activity of metsulfuron-methyl on *Diodia ocimifolia* was influenced by herbicide dosage, carrier volume, surfactant and the interaction of these factors. The performance of metsulfuron-methyl increased as herbicide dosage increased irrespective of carrier volume. The results indicated that 30 g/ha metsulfuron-methyl was required for effective control of *Diodia*. A significant decrease in performance of metsulfuron-methyl was observed as the carrier volume increased from 200 to 600 L ha^{-1}. The presence of surfactant increased the activity of

metsulfuron-methyl against *Diodia* at carrier volumes of 400 and 600 L ha^{-1}. However, the results did not indicate loss in herbicide performance for carrier volume less than 200 L ha^{-1} in the absence and presence of surfactant. These observed responses were further illustrated using models obtained by linear regression analysis. Metsulfuron-methyl applied to *D. ocimifolia* at both growth stages caused seedling mortality and reduced seed production. *Diodia ocimifolia* was more susceptible at the vegetative stage compared to the flowering stage. Shoot tip growth was arrested at low dosage of 3.75 g/ha. However, metsulfuron-methyl dosage required for complete kill of *Diodia* seedlings was 15 g/ha at the vegetative stage and 30 g/ha at the flowering stage. Metsulfuron-methyl applied at the flowering stage caused flower abscission but did not inhibit germination of seeds collected from treated plants. Metsulfuron-methyl and glyphosate mixtures at all ratios were more effective than the herbicides used alone. At low rates of metsulfuron-methyl (3.75 and 15 g/ha), the response in the presence of glyphosate (135 and 540 g/ha) with and without surfactant (1:36 mixtures) was synergistic or additive. However, in the 1:72 mixture the interaction response became additive. The same response was obtained with the 1:18 mixture. The results indicate that the appropriate combination for optimum performance is the 1:36 mixture both in the presence and absence of surfactant. The percent inhibition data expressed graphically using isobole method showed synergistic interaction

between metsulfuron-methyl and glyphosate in the presence and absence of surfactant.

Abstrak tesis ini diserahkan kepada Senat Universiti Putra Malaysia sebagai memenuhi syarat untuk mendapatkan Ijazah Master Sains Pertanian

PENGARUH CIRI FIZIKAL SEMBURAN DAN PENAMBAHAN GLIFOSAT TERHADAP PENINGKATAN KEBERKESANAN METSUFURON-METIL KE ATAS 'WOODY BORRERIA' (*Diodia ocimifolia*)

Oleh

Ooi Kok Eng

Januari 1999

Pengurusi : Prof. Madya Dr Rajan Amartalingam

Fakulti : Pertanian

Kesan ciri-ciri fizikal penyemburan (isipadu semburan, kadar racun herba and surfaktan) dan penambahan glifosat dalam meningkatkan keberkesanan metsufuron-metil ke atas 'woody borreria' (*Diodia ocimifolia*) telah dikaji di rumah kaca. Keberkesanan metsufuron-metil ke atas *D. ocimifolia* dipengaruhi oleh kadar racun herba, isipadu semburan, surfaktan dan interaksi antara tiga faktor tersebut. Keberkesanan metsulfuron-metil meningkat dengan meningkatnya kadar racun herba. Keputusan diperolehi menunjukan 30 g/ha metsulfuron-metil diperlukan untuk memberi kawalan yang berkesan ke atas *Diodia*. Keberkesanan metsulfuron-metil menurun dengan meningatnya isipadu semburan dari 200 ke 600 L ha^{-1}. Kehadiran surfaktan meningkatan keberkesanan

metsulfuron-metil ke atas *Diodia* pada isipadu semburan 400 dan 600 L ha^{-1}. Namun, kehadiran surfaktan pada isipadu semburan 200 L ha^{-1} tidak menunjukan sebarang perubahan ke atas keberkesanan metsulfuron-metil. Pemerhatian terhadap respon tersebut kemudian telah diilustrasikan secara model dengan menggunakan analysis regrasi linear. Rawatan metsulfuron-metil ke atas *D. ocimifolia* pada kedua-dua peringkat pertumbuhan menyebabkan kematian dan mengurangan penghásilan biji benih. *Diodia ocimifolia* pada peringkat vegetatif adalah lebih peka berbandingkan dengan peringkat pembungaan. Kadar serendah 3.75 g/ha adalah memadai untuk menghalang pertumbuhan pucuk terhenti. Namun demikian, kadar metsulfuron-metil yang diperlukan untuk menyebabkan kematian sepenuhnya adalah 15 g/ha pada peringkat vegetatif dan 30 g/ha pada peringkat pembungaan. Keguguran bunga berlaku apabila metsulfuron-metil dirawat pada peringkat pembungaan. Walau bagaimanpun, metsulfuron-metil tidak menghalang percambahan biji benih yang dikutip daripada pokok yang telah dirawat. Campuran metsulfuron-metil and glifosat pada semua nisbah yang diuji adalah lebih berkesan berbanding dengan rawatan racun herba secara berasingan. Pada kadar rendah metsulfuron-metil (3.75 dan 15 g/ha), campuran glifosat (135 and 540 g/ha) dengan dan tanpa kehadiran surfaktan (campuran 1:36) menunjukan respons sinergistik dan aditif. Namun, pada campuran 1:72, respons interaksi tersebut bertukar kepada aditif. Campuran 1:18 juga menunjukan respons yang sama. Keputusan ini

menunjukkan campuran yang paling sesuai untuk mendapatkan kesan optima adalah 1:36 dengan dan tanpa kehadiran surfaktan. Data peratus perencatan pertumbuhan yang di gambarkan secara graf dengan kaedah isobole menunjukan respons sinergistik bagi interaksi metsulfuron-metil dan glifosat dengan dan tanpa kehadiran surfaktan.

CHAPTER I

INTRODUCTION

Pesticide application technology is an important component of pest management in today's agriculture. Choice of suitable physical and chemical spray characteristics determine effectiveness and efficiency of spray applications. Correct choice will determine the success of achieving desired weed control and the best balance of effectiveness and crop safety; it minimizes any possibility of adverse environmental effects.

Tremendous progress has been made in the development of synthetic crop protection agents over the last 30 years. However, the development of equipment for pesticide delivery has received comparatively little attention. In Malaysia, the conventional knapsack sprayer (CKS) has been used extensively since the introduction of chemical weed control in the 1950s (Teoh, 1992). Although a recent survey showed that the knapsack sprayer remains the most commonly use

spraying equipment in estates, there has been a major shift towards very low volume (VLV) and ultra low volume (ULV) application using controlled droplet applicators (CDA) and mistblowers (Teoh and Chung, 1991). Among various factors that could have influenced the recent changes, the labor situation in Malaysia and developments in the agrochemical industry had the most significant impact. Environmental and economic concerns have also created renewed research interest in methods of improving efficiency of herbicide application. The goal of any spray operation should be to apply herbicides effectively on the target species without compromising environmental and user safety.

Besides the spray equipment, the spray nozzle also plays an important role in application accuracy. The oldest principle of atomization, the hydraulic spray nozzle, is still the most widely used today and the basic design of hydraulic sprayers has changed only little over the last 100 years. Most of these nozzles produce a broad droplet-size distribution and hence, the need for medium to high carrier volumes. In theory, application of a narrow droplet-size distribution, which allows carrier volumes to be reduced should be more efficient. This is due to reduction in small droplets which are prone to drift and large wasteful droplets which are poorly retained. A number of reports show significant improvement in herbicide efficacy as a result of a change in carrier volume (Buhler and

Burnside, 1987; Smeda and Putnam, 1989) or droplet size (McKinlay *et al*, 1974; Merritt, 1982)

Surfactants are commonly used with post-emergence herbicides to enhance performance and improve spray coverage (Nalewaja and Adamezewski, 1977; Varshney and Singh, 1990). Foy *et al* (1965) found that the use of surfactants is mainly to reduce surface tension or alter the viscosity and density of the spray solution. Many surfactants also alter the cuticular waxes on the leaf surface which may enable herbicides to penetrate the cuticle. Increased absorption may allow for reduced herbicide rates (Wanamarta and Penner, 1989). Surfactants also affect the behaviour of both spray deposition on difficult-to-wet leaf surfaces and spray retention. This could be particularly important at higher carrier volume application when the spray solution retained on the leaf is near saturation capacity and spray solution run-off could be exacerbated by the presence of surfactant.

Few studies have examined both the independent and combined influence of droplet size, carrier volume and surfactant concentration on herbicidal activity. In general, a complex interaction occurs among plant species, surfactant, herbicide, and environment. Thus, it is very important