BORNEO SCIENCE 15: 37-44, JUNE 2004

LOWER CONCENTRATION OF METHYL OLEATE IMPROVED THE EFFICACY OF GLYPHOATE APPLICATION

Chong Khim Phin[1] & Dzolkhifli Omar[2]

[1]School of Science and Technology, Universiti Malaysia Sabah,
88999, Kota Kinabalu, Sabah, Malaysia
[2]Department of Plant Protection, Universiti Putra Malaysia,
43400, Serdang, Selangor, Malaysia

ABSTRACT. *The effects of adding methyl oleate in comparison with ammonium sulphate in the preparation of glyphosate formulation and Round up® standard for controlling* Diodia ocimifolia *and* Mikania micrantha, *two species of weeds commonly found in oil palm and rubber plantation six were evaluated in the glass house. The six weeks old plants were sprayed with 1.23 kg a.i of glyphosate per hectare and spray volume of 200 L/ha. Formulation of glyphosate with methyl oleate 1 % showed the highest spray deposition on both weed species. In visual assessment, similar formulation showed the highest percentage of mortality on both weeds at 7 and 10 days after treatment. A similar result was observed on the reduction of leaf chlorophyll, which 1% of methyl oleate gave the best result. For fresh and dry weight, methyl oleate with concentration of 1% also performed the best result in reducing the weight of both species.*

KEYWORDS. Methyl oleate, *Diodia ocimifolia*, *Mikania micrantha*, glyphosate, ammonium sulphate

INTRODUCTION

Weeds cause major problems in crop production. They compete with crops and reduce yield, harvesting efficiency and crop quality (Clay *et al.*, 2000). It is estimated that weeds are responsible for an overall reduction of more than ten percent in the yield of major world crops, representing a huge annual loss of food supplies (Roberts, 1982). Once alien weeds are widely established, strategies for minimizing their damage are limited to containment of existing infestations and long term suppression (Skinner, 2000)

The cost of applying herbicides is much higher compared to other pesticides. In a year, it is estimated that 51% of the pest management cost are from herbicides application, 35% and 14% from insecticides and fungicides respectively (Eichers, 1981). Thus, effective application should be done to lower the cost. Glyphosate is a non-selective, that offers total kill control over a wide variety of annual and perennial weeds and grasses. It is a systemic herbicide which penetrates into the phloem and xylem before being tranlocated to other parts of the plant (Ruiter *et al.*, 1998). It is particularly very useful in controlling most perennial weeds and annual grasses (Martin

and Worthing, 1974). It is easily absorbed by most weed species and highly mobile in the phloem and xylem (Devine, 1993).

The effectiveness and the quality of this herbicide can be increased further through the addition of adjuvant such as surfactants (Turner and Loader, 1980) and oil (Hamilton, 1993). Surfactant or 'Surface Active Agent' has been used in most of the aspects in our life especially in detergents and personnel care products or directly in some production and processing of the materials (Karsa, 1987) In the agrochemical industry, surfactants are used to improve the physical and chemical characteristics of the spray solution and to enhance the uptake of the active ingredient in the spray solution, droplet spreading, spray retention and drying rates (Gaskin and Holoway, 1992).

The development of organosilicone based surfactant in pesticide formulation has improved the foliar uptake of glyphosate due to good wetting and penetrating properties compared to conventional surfactants (Bishop and Field, 1983) But, recently, the use of crop seed oils such as soybean, sunflower, canola and coconut as a surfactant have been introduced. They are good, economical, locally supplied and renewable source of adjuvant (Matthews and Hislop, 1993). Oleochemical surfactants have both economic and ecological advantages over the mineral oil surfactants (Baumann and Biermann, 1973). However, there is lack of information on the use of oleo palm oil as a solvent in herbicides.

The potential of using palm oil as a type of solvent has been proven effective as soya bean oil (Noor, 1995). The development of oleo palm oil has linked to a new development of solvent in herbicides

The objective of this experiment is to determine the effectiveness of different concentrations of methyl oleate in glyphosate formulation in killing two species of broad-leave weeds.

MATERIALS AND METHODS

Weeds were grown using seedlings and vegetative parts. Good vegetative parts of *Mikania micrantha* and seedlings of *Diodia ocimifolia* were selected. Seedlings and vegetative parts were grown in UPM's green house. They were planted in pots with soil ratio of three part of top soil: two part of organic matter: 1 part of sand. Each pot contained two seedlings or vegetative parts. Four pots were used per replication. Three replications for each treatment.

Pots were watered everyday and fertilized after four weeks with green NPK. After six weeks, the rooted stolons and seedlings were sprayed with 1.23 a.i of glyphosate/ha and spray volume of 200l/ha in the following formulations: glyphosate technical + Methyl oleate 10% + Surfactant (T1), glyphosate technical + Methyl oleate 5% + Surfactant (T2), glyphosate technical + Methyl oleate 1 % + Surfactant (T3), glyphosate technical + Ammonium Sulphate 8% + Surfactant (T4), Round up® standard (T5) and Control (T6). The experiment was conducted using a Complete

Randomized Design (CRD) with three replications. Data were collected based on four parameters which were, visual evaluation, fresh and dry weight of treated leaves, spray depositions and chlorophyll content Data obtained were analyzed using ANOVA and means were separated using Tukey. The spray deposition was measured using Sequioq-Turner model 450 Digital Fluorometer at 485 nm wave length. All parts of both weed species were cut and weighed to get the wet and dry weights after treatments. Evaluation of mortality percentage was based on Burill (1976) and chlorophyll content was measured using a spectrophotometer (Model Prim Visible Light, Secomam). Absorbence was measured at 663 and 645 nm wavelength and calculated according to Coombs (1982).

SUMMARY OF FINDINGS

Spray deposition. In *Mikania micrantha,* result showed that the highest spray deposition occurred in glyphosate formulation containing 1 % methyl oleate (T3) followed by T4. T1 and T2 showed no significant different, T5 showed the lowest spray deposition. In *Diodia ocimifolia,* T3 showed the highest spray deposition, but no significantly was observed between T1 and T4. T2 showed a lower spray deposition compared to T5. The different angle and leaves arrangement for both types of weeds give different interception of spray. *Diodia ocimifolia* has erect leaves which presents a relatively small target to a vertical spray and receive relative little spray per unit area of leaf (Roberts, 1982). This is the reason why both species showed different response to the same treatment (Figure 1).

Percentage of mortality. All treatments showed no significant differences on day 3 after treatment, but significant was observed at day 7 with formulation of 1% methyl oleate (T3) giving the highest percentage of mortality on *Mikania micrantha,* followed by T5 and T1 but there were no significant different between the treatments. This could due to the translocation process of glyphosate to other parts. Glyphosate sprayed on the leaf will be translocated to other part of weed after 5 days of treatment (Zandstra, 1974). T2 and T4 showed the poorest result with no significant different between both of them. At day ten, all treatments showed no significant different except T3 that perfomed 100% mortality. All treatments achieved 100% mortality at day 14 (Figure 2). In *Diodia ocimifolia,* T3 performed the best result at day 3 with no significant different in other treatments. At day 7, T1, T3 and T4 exhibited the best result with no significant different among all treatments. At day 10 , T3 achieved 100% mortality. Oil can destroy the cell wall and enhance the penetration of glyphosate (Ashton, 1991) with methyl oleate showed the highest percentage of mortality after 7 days of treatment (Figure 3).

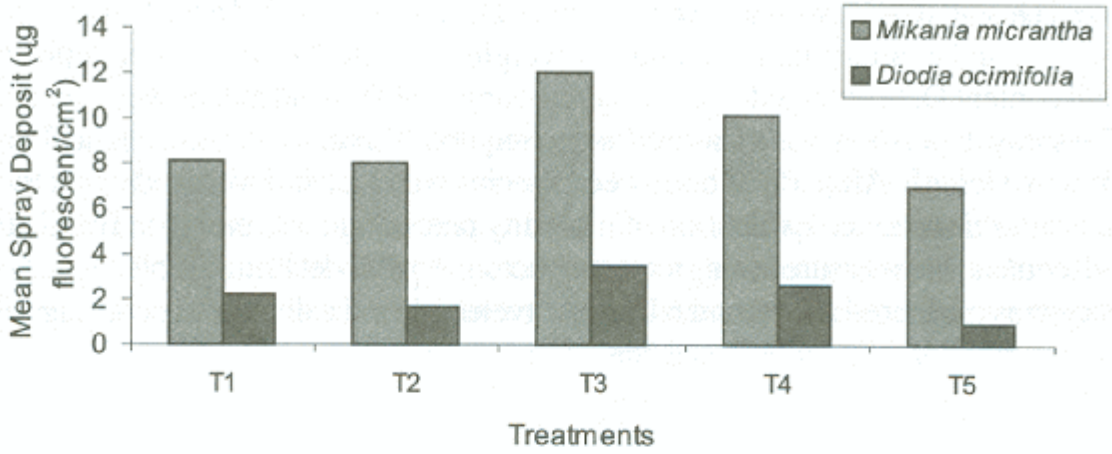


Figure 1. Spray deposition of several formulations of glyphosate on leaf surface of *Mikania micrantha* and *Diodia ocimifolio*. Means followed by different letters are significantly different at P<0.05 by Tukey test.

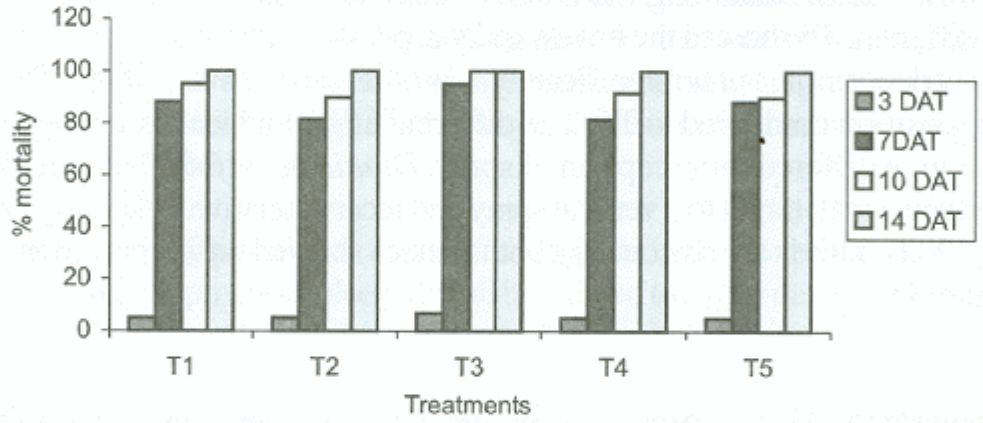


Figure 2. Effect of several formulations of glyphosate in % of mortality of *Mikania micrantha*. Means followed by different letters are significantly different at P≤0.05 by Tukey test.

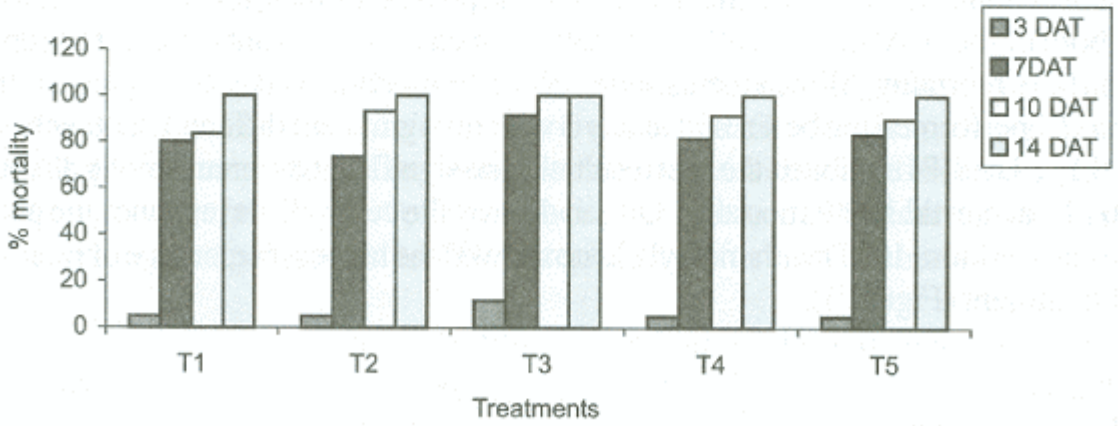
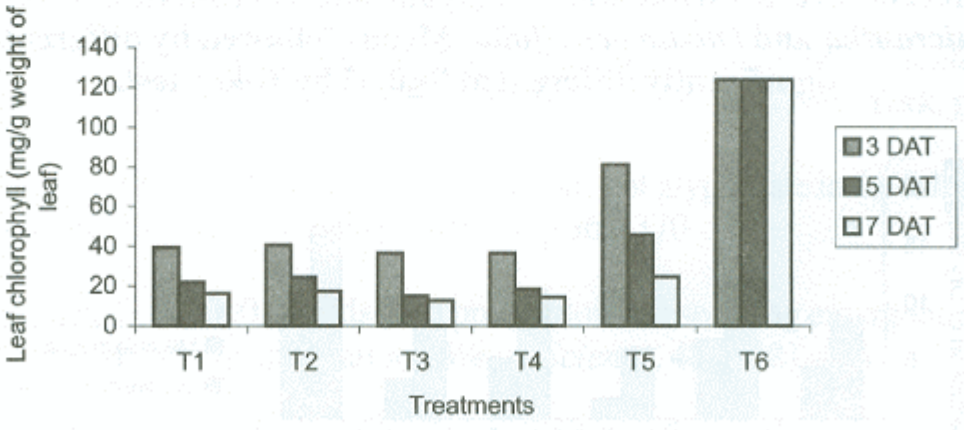


Figure 3. Effect of several formulations of glyphosate to % of mortality of *Diodia ocimifolia*. Means followed by different letters are significantly different at P≤0.05 by Tukey test.

Leaf chlorophyll. On day 3 all treatments showed significant differences as compared to control. After five days of treatment, formulation containing 1% of methyl oleate reduced the leaf chlorophyll level to minimum compared to 10% and 5% of methyl oleate in the formulations for both *Mikania micrantha* (Figure 4) and *Diodia ocimifolia* (Figure 5). This was true according to Santier and Chamel (1996) investigation that methyl oleate caused significant increases in penetration of *[^{14}C] quizalofop-ethyl* and *[^{14}C] fenoxaprop-ethyl* into plant cuticle of tomato, pepper and rubber after 72 hours. Methyl oleate helped glyphosate to penerate easily through the plant cuticle. Then, glyphosate reacted with the weed chlorophyll cells, destroyed and reduced the chlorophyll level

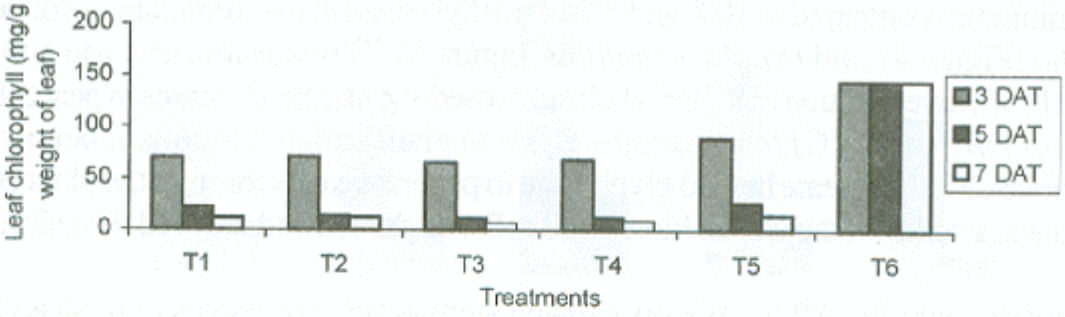
Fresh and dry weight. All treatments showed significant differences in fresh and dry weight compared to control. Formulation with 1% methyl oleate showed lowest fresh (Fig. 6) and dry weight (Fig. 7). According to Halloway and Stock (1990) the use of wetting agent such as oil is another means to increase the selectivity of a product and to obtain weed control. This system of increasing the effect of a herbicide by mixing it with an adjuvant has experienced a revival. Methyl oleate was oil-based that increased the selectivity and performed a better result in reduction of fresh and dry weight.

In general, 1% methyl oleate in glyphosate formulation produced better results compared to other concentrations. It provides bigger spray droplets and increased the killing rate of plants. It helped to cut through the waxy surfaces and leaves to allow penetration of active ingredients and reduced leaf chlorophyll to a minimum level thereby reducing the physiological functions of weed plants. This is in accordance with the finding of Shah (2000), which methyl oleate showed high uptake of glyphosate and good efficacy that suggested them to be useful in pesticide formulation in enhancing the efficacy of herbicide



(DAT-Day after treatment)

Figure 4. Effect of several formulations of glyphosate to leaf chlorophyll of *Mikania micrantha*. Means followed by different letters are significantly different at P≤0.05 by Tukey test.



(DAT-Day after treatment)

Figure 5. Effect of several formulations of glyphosate to leaf chlorophyll of *Diodia ocimifolia*. Means followed by different letters are significantly different at P≤0.05 by Tukey test.

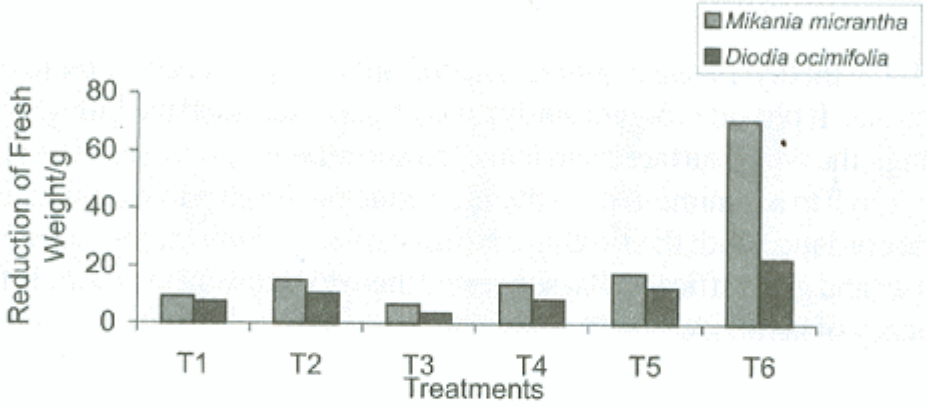


Figure 6. Effect of several formulations of glyphosate on reduction of fresh weight/g of *Mikania micrantha* and *Diodia ocimifolia*. Means followed by different letters are significantly different at P≤0.05 by Tukey test.

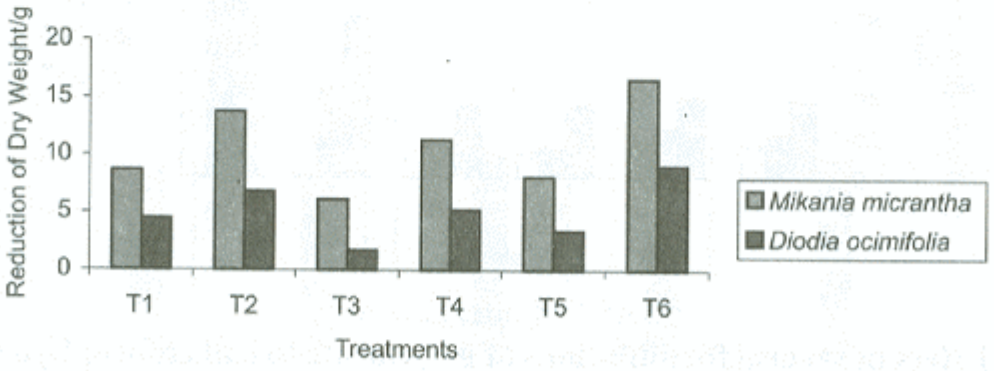


Figure 7. Effect of several formulations of glyphosate on reduction of dry weight of *Mikania micrantha* and *Diodia ocimifolia*. P≤0.05 by Tukey test.

CONCLUSION

The use of different concentrations of methyl oleate in glyphosate formulation gave better control of *Mikania micrantha* and *Diodia ocimifolia* compared to the Round up® standard, control and formulation with addition of ammonium sulphate treatment. The 1 % methyl oleate concentration in glyphosate consistently gave the best result for all the parameters indicating improvement in the efficacy of glyphosate application.

NOMENCLATURE

T1: Glyphosate technical + Methyl oleate 10% + Surfactant
T2: Glyphosate technical + Methyl oleate 5% + Surfactant
T3: Glyphosate technical + Methyl oleate 1 % + Surfactant
T4: Glyphosate technical + Ammonium Sulphate 8% + Surfactant
T5: Round up® standard
T6: Control

REFERENCES

Ashton, F.M and Monoco, T.J. 1991. *Formulation, drift and calculation. Weeds Science: Principle and Practice.* Wiley Interscience Publication, New York. p 100-111

Baumann, H. and Biermann, M. 1973. *Penetration and translocation of herbicides in pesticide formulation.* Valkenburg, W. V (Eds). Markel-Decker, Inc. New York. p 387-439

Bishop, N.G. and Field R. J. 1983. Improved performance of glyphosate in the full season control of perennial Rye Grass. *Asp. Appl. Biol.* **4**: p 363-370

Clay, P.A and James, L.G. 2000. Weeds seed production and seedling emergence responses to late season glyphosate applications. *Weeds Science.* **48**: p 481-486

Coombs, J. Hall, D.O. Long, S.P and Scurlock, J.M.O. 1982. *Chlorophyll determination. Chlorophyll in technique in bioproductivity and photosynthesis.* Pergamon Press. p 223-224

Devine, M. 1993. *Herbicides translocation. Physiology of herbicides.* p 20-4, 72-79 and 251-263

Eichers, T. 1970. *Quantities of pesticides used by farmers in 1966*. Washington: Economic Research Service, USDA

Gaskin, R.E and Holoway, P.J. 1992. Some physico-chemical factors influencing foliar uptake enhancement of glyphosate mono isoprophylammomium by polyethoxylene surfactant. *Pesticides Sci.* **34**: p 195-206

Halloway, P. J. and Stock, D. 1990. In: Industrial applications of surfactants II, Ed. Karsa D. R., Spec. *Publication No. 77, Roy. Soc. Chem.*, Cambridge. p 303-337

Hamilton, R.J. 1993. Structure and general properties of mineral and vegetable oils used as spray adjuvant. *Pesticides. Sci.* **37**: p 141-146.

Karsa, D.R. 1987. *Industrial applications of surfactants an overview in industrial application of surfactants (Karsa Ed.)* The Royal Society of Chemistry, London

Martin, H. and Worthing, C.R. 1974. *Pesticides Manual*. BCPC

Mathews, G.A and Hislop, E.C. 1993. *Application technology for crop protection.* CAB International

Noor, H. 1995. Keberkesanan glifosat apabila dicampur dengan minyak kelapa sawit terhadap *Cyperus rotundus*. Projek Tahun Akhir Bacelor Sains Bioindustri. Jabatan Perlindungan Tumbuhan. Universiti Pertanian Malaysia

Roberts, H.A. 1982. (7th Ed.) *Weed Control Handbook: Principles*.. British Crop Protection Council. Blackwell Scientific Publications. p 65

Ruiter, D.R and Meiren, E.1998. Influence of water stress and surfactant on the efficacy, absorption and translocation of glyphosate. *Weeds Science,* **46**: p 289-296

Santier and Chamel. 1996. Penetration of glyphosate and diuron into and through isolated plant cuticles. *Weeds Research,* **32**: 337-347

Shah, Z.M. 2000. Evaluation of palm oil oleochemicals as herbicide surfactant. Master's Thesis. Department of Agronomy and Horticulture. Faculty of Agriculture. Universiti Putra Malaysia

Skinner, K. Smith, L and Rice, P. 2000. Using noxious weeds lists to prioritize targets for developing weed management strategies. *Weeds Science,* **48**: 640-644

Turner, D.J. and Loader, M.P.C. 1980. Effect of ammonium sulfate and other additives upon the phytotoxicity of glyphosate to *Agropyron repens* (L) Beauv. *Weeds Sci.*, **20**: 139-158

Zandstra, B.H. Teo, K.M and Nishimoto, R.K. 1974. Response of purple nutsedge to repeated application of glyphosate. *Weed Sci.*, **22**: 230-232.