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Efficacy of Metsulfuron-Methyl Doses for Controlling Rat Caladium (Typhonium blumei) in an Oil Palm Plantation

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ABSTRACT

Effectiveness of controlling rat taro weed (Typhonium blumei) with various doses of the herbicide Methyl metsulfuron on oil palm plants (Elaeis guineensis Jacq) at PT Umada Kebun Pernantian. This research to evaluated the effectiveness control weed taro mouse (Typhonium blumei) against giving various doses of herbicide Metsulfuron methyl in palm oil plants. This study was implemented from April 2024 to June 2024 and is located in division 1, block 6, PT Umada Kebun Pernantian Regency, North Labuhanbatu, North Sumatra Province. Use a non-factorial randomized group design (RAK), consists of 6 levels, namely, control (M0), 15 gr/ cap (M1), 30 gr/ cap (M2), 45 gr/ cap (M3), 60 gr/ cap (M4), 75 gr/ cap (M5). Every treatment repeated four times. Observed parameters covers scoring visualization weed, weed growth inhibited, and percentage death weed. Data were analyzed by analysis of variance followed by Duncan's Multiple Range Test at the 5% level. At 5 weeks after application (WAA), M3, M4, and M5 produced visual injury of 83, 79, and 84%, respectively, and all three treatments produced a growth-inhibition score of 4.0. Weed mortality at 5 WAA was 73.8% for M3, 72.95% for M4, and 77% for M5. Because M3 produced responses statistically comparable with the higher doses for the principal efficacy variables, 45 g per knapsack sprayer was the lowest tested dose providing comparable control under the conditions of this study.

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1. INTRODUCTION

Production of oil palm is regardless of management, the right plant. Management plant covers activity seeding, planting, fertilizing, harvesting and controlling pests (organisms Bully Plants) such as pests, diseases plants and weeds. PPKS (2010) in Prasetyo et al., (2016) areas dominated by noxious weeds or competitors heavy like sembung creeper (*Mikania micrantha*), taro mouse (*Typhonium blumei*), reeds (*Imperata cylindrica*), and *Asystasia coromandeliana* can lower production up to 20%.

Weeds in the plantation of oil palm, besides giving rise to competition with plants, are also annoying in the smoothness activity garden. Weeds in the gate can be difficult to harvest, citation loose, and reduce the effectiveness of fertilization. Weeds at the picket market can bother movement power Work. Smoothness disrupted activities can reduce productivity power work

(PPKS, 2010 *in* Prasetyo et al., 2016). Losses caused by weeds are not seen in a direct way. A number of causal factors emergence loss consequence competition between plant plantations and weeds including growth plant hampered so that time start producing longer, decrease quantity and quality results production plants, productivity work disturbed, weed can become nest pests and diseases, as well cost control very expensive weed (Barus, 2003 *in* Prasetyo et al., 2016).

Use material chemicals (herbicides) are used in control weeds in plantations because the result fast and effective. One of material active in herbicides is *Metsulfuron methyl*. *Metsulfuron methyl* can be used for all type weeds; one of the most effective is weed gummy and leafy wide, with activity systemic, where symptom poisoning new can be seen in 2-4 days after application for weed annuals, whereas for weed annuals after 10 days or more (Soekarjo and Soejono, 2015).

Effort to increase productivity plants at PT. Umada can be done through activity proper maintenance; for one, control weeds are done manually, mechanically, or chemistry. Material chemicals (herbicides) are used to control weeds in plantations because the result is fast and effective. One of materials active in herbicides is *Metsulfuron methyl*. *Metsulfuron methyl* can be used for all types of weeds; one of the most effective is weed gummy and leafy wide, with activity systemic, where symptom poisoning can be seen in 2-4 days after application for weed annuals, whereas for weed annuals after 10 days or more (Soekarjo and Soejono, 2015).

Effective strategy in controlling weed in a way chemical there are two, namely, with do rotation herbicides and their presence mixing use herbicide. Mixing material herbicide with material different active aims to get control over a more board spectrum and is expected to slow down emergence resistance weeds to herbicide, reducing cost production, and reduce residue herbicide (Soekarjo and Soejono, 2015).

A study previously conducted by Sari et al., (2021) entitled Pre-Grown Bioherbicide of Alang-Alang Rhizome *(Imperata cylindrica*) for Weed Control in Oil Palm Plantation Areas. Obtained results show that the *Imperata cylindrica* weed can be used as an alternative pre-emergent bioherbicide for weed control in oil palm plantation areas. Pre-emergent bioherbicide *Imperata cylindrica* has a significant effect on the growth capacity of weeds. Then further research was carried out by Prayetno et al. (2017) regarding the Effect of Compound Herbicide Effectiveness (*Glyphosate* + *Metsulfuron Methyl*) for Weed Control in Oil Palm Plantations. The results of the experiment showed that the application of the compound herbicide *glyphosate* + methyl metsulfuron at a low concentration of 1,117.8 grams/ha + 75 grams/ha showed the best results in controlling weeds in oil palm plantations. Therefore, this study aimed to evaluate the response of T. blumei to different doses of metsulfuron-methyl and to identify the lowest tested dose that provides effective control based on visual injury, growth inhibition, and weed mortality in an oil palm plantation.

2. METHOD

2.1 Preparation for Controlling Rat Caladium Weed

This research was carried out for 2 months, namely April to June 2024. The Rat Caladium weed (*Typhonium blumei*) that was given this treatment was in the garden of PT Umada Kebun Pernantian, South Labuhanbatu Regency, precisely in division 1 block 6. This weed grows well in the area oil palm plantations until it spread to the main crop, namely oil palm plants.

2.2 Research Tools and Materials

The tools used in this research are: 15liter bamboo spayer knapsack, string of raffia, digital scales, stationery, masks, aprons, gloves, boots, wooden sign as sample marker. The materials used in this research are: herbicide *Methyl metsulfuron* type *Ally 20 WG* (*Water Granule*), rat caladium weed (*Typhonium blumei*).

This research uses quantitative research methods, which can be interpreted as research methods based on the philosophy of positivism that are used to research certain populations or samples. Data collection uses research instruments and quantitative/statistical data analysis with the aim of testing predetermined hypotheses (Sugiyono, 2019).

This type of research is experimental quantitative research. The method is to compare one or more experimental groups that were treated with one or more comparison groups that did not receive treatment. The processed data will then be displayed as a *line-point graph,* which is used as a parameter to draw conclusions from the overall data using the standard deviation for each replication, then described based on the available data. The type of quantitative experimental research used in this research is the Randomized Group Design (RAK), according to Mardinata (2013), namely an environmental design where random assignment of treatments to each experimental unit is carried out in each group or block.

Non-factorial RAK is a restricted random design by first grouping experimental units into homogeneous groups, called blocks, and then randomly assigning treatments within these groups. This design is best used if the heterogeneity of the experimental units comes from a single source of diversity. The unit diversity component that needs to be considered in determining group formation is the diversity component outside the treatment, which also influences the response of the experimental unit (Susilawati, 2015). The research data were analyzed using a non-factorial randomized block design (RAK) using variance, then tested further with the significant difference test using the *Duncan Multiple Range Test (DMRT).*

This research used a non-factorial randomized block design with 6 levels, namely as follows: Mo: Without any treatment (control); M1: 15 gr/cap; M2: 30 gr/cap; M3: 45 gr/cap; M4: 60 gr/cap; M5: 75 gr/cap (*Knapsack Sprayer*)

2.3 Measured parameters

2.3.1 Weed visualization

Reporting from Big Indonesian Dictionary (2024) Visualization is the expression of an idea or feeling using images, writing (words and numbers), maps, graphs, and so on so as to interpret observations made objectively through physical changes in the weed. Observation this is done on day of 7, 14, 21, 28, and 35 days after the application. Visualization scoring standards taken from the control SOP PT Umada weed are as follows:

Table 1. Visual Scoring

Weed Mortality Rate	Symptoms
0	No symptoms
10 – 30	Has changed color but has not wilted
40 – 60	Withered but has not undergone a change in shape
70	Wilted and yellowed
80	Drought levels reach 80%
90	The leaves dry out completely, but the stems still wilt
100	Perfect, no live weeds

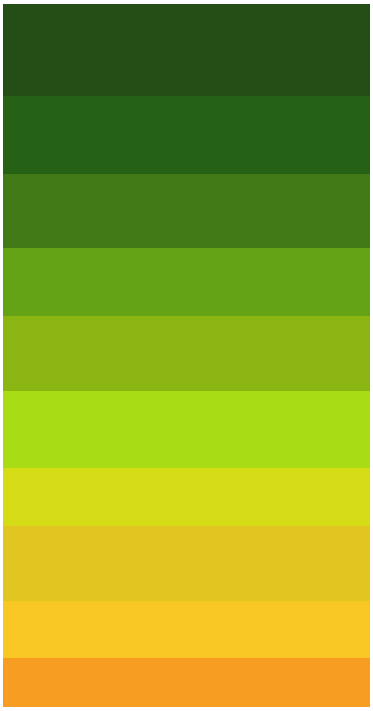

Figure 1. Leaves Color Chart

2.3.2 Stunted growth weeds

Herbicides are shared into two areas, viz., herbicide systemic and herbicide contact. Herbicide systemic is penetrating herbicide network plants, meanwhile herbicide contact is destructive herbicide activity herbicide part plant. Herbicide is material chemistry; deep the right amount, in fact temporary or permanent, hinders growth of weeds (Dika, 2022).

According to Fuadi and Wicaksono (2018), the determination score weeds growth hampered by observation through the following:

- 0 = no poisoning occurs (with a poisoning level of 0-5%, the shape and color do not change at

all).
- 1 = mild poisoning (with a poisoning level of 5-25%, the color of the leaves changes slightly).
- 2 = moderate poisoning (with a poisoning level of 25-50%, the leaves wilt and the color changes).
- 3 = severe poisoning (with a poisoning level of 50-70%, wilted leaves, and yellow leaf color evenly).
- 4 = very severe poisoning (with a poisoning level of >70%, the shape and color of the leaves change completely, so that the leaves dry out and the weeds die). These observations were made on days 7, 14, 21, 28, and 35 days after application.

2.3.3 Percentage of weed death

Metsulfuron methyl can hinder activity enzymes involved in the synthesis of glutamine. Enzymes are required for producing glutamine amino acids and detoxifying ammonia, so photosynthesis stopped and finally caused death weeds (Silaban and Nugroho, 2017). Percentage value level weed calculated with formula as follows:

$$Weed\ death = \frac{dead\ weeds}{weed\ population} x\ 100\ \% \quad (1)$$

Percentage death is done on the day final or on the day to 35 after application.

2.4 Data collection technique

The data collected in this research includes primary data and secondary data. Primary data was obtained directly through field observations. Secondary data was obtained from various sources, namely BPS, journals, and companies related to this research.

The data collection technique used in this research is by using the method: Observation is data collection by directly observing the conditions of the research target to obtain related data in the field. Various sources, such as BPS, journals, scientific articles, and from PT Umada Kebun Pernantian. Documentation, namely data collection techniques by viewing or analyzing documents that correspond to actual facts in the field in the form of images.

2.5 Analysis Statistics

The experiment was analyzed using the *Analysis of Variance* (ANOVA) method, and the significantly different treatments were followed by the *Duncan Multiple Range Test* (DMRT) 5% mean difference test (Malela et al., 2016). Data analysis used an experimental design with the Excel program and SPSS 26 application.

3. RESULTS AND DISCUSSION

3.1 Visualization scoring weed

Observation data scoring visualization weed taro mouse with treatment application herbicide *Metsulfuron methyl* at periods of 1, 2, 3, 4, and 5 weeks after application (WAA), along with table anova test analysis and further tests DMRT 5% level in SPSS 26 can be done as seen in Appendix 2-11. Based on fingerprint data results, variation obtained in the treatment method application herbicide *Metsulfuron methyl* in the Period 1 WAA to 5 WAA has an effect real on scoring parameters visualization weed.

Table 2. Scoring Visualization Weeds with Treatment Application Herbicide *Metsulfuron methyl* in periods 1, 2, 3, 4, and 5 WAA

Treatment	Weeks after application (WAA) %				
	1	2	3	4	5
M0	0c	0c	0c	0b	0c
M1	7.5b	12.75b	15.25b	27.75a	43.5b
M2	7.25b	12.75b	20.75a	40.75a	67.5a
M3	12.25a	23.00a	25.5ab	43a	83a
M4	15.25a	22.00a	25.5ab	32.75a	79a
M5	13a	21.75a	25a	41.25a	84a

Note: Numbers followed by letters that are not the same in the same column are significantly different according to the 5% DMRT test.

Based on Table 2, the herbicide *Metsulfuron methyl* had a significant effect, namely with M5 treatment in weeks 1 to 5. The best results were found at 5 WAA with M5 treatment (84%) significantly different from M1 treatment (43.5%), but the levels of treatment M2 (67.5%), M4 (79%), M3 (83%), and M5 (84%) have a significant effect. For treatment, the highest yield was in treatment M5 (84% at 5 WAA), and for treatment, the lowest yield was in treatment M1 (43.5%) at 5 WAA. Likewise, M0 does not show weed visualization because there is no change at all in the weed visualization scoring parameters.

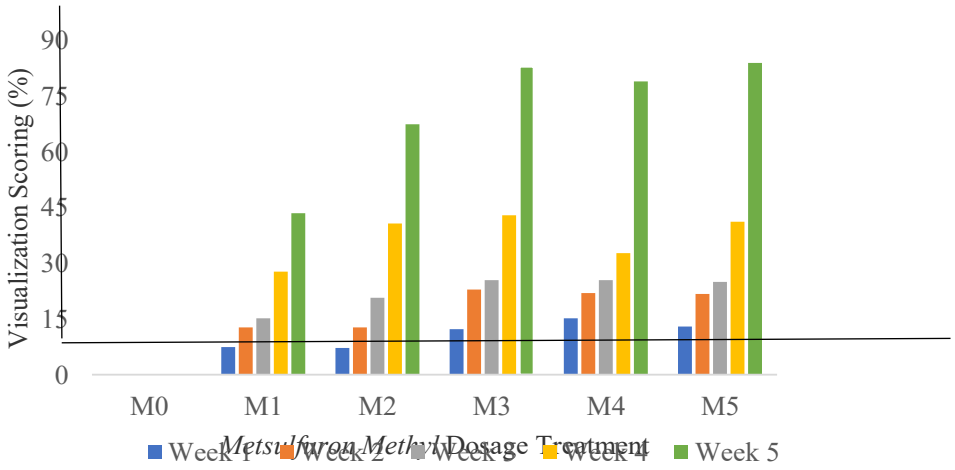

Figure 2. Scoring Average Visualization Weeds

Based on Figure 1, it shows the weed visualization scoring parameters and doses that are effective in controlling weeds in the plate and pikul markets with a dose of M1 dose of 15 gr/kep, M2 dose of 30 gr/kep, M3 dose of 45 gr/kep, and M4 dose of 60 gr/kep as well as M5 with a dose of 75 gr/kep. This can be seen from the increase every week in each treatment which shows that the impact of the herbicide *Metsulfuron methyl* affects the growth of weeds as seen visually. *Metsulfuron methyl* herbicide selectively controls broadleaf weeds, in accordance with the statement of Khasanah et al. (2014). *Methyl metsulfuron herbicide* is a selective herbicide for controlling broadleaf weeds. This proves that the applied *metsulfuron methyl herbicide is able to suppress weed growth.* If applied to a company, it is better to use M3 with a dose of 45 gr/kep, considering that the dose used is smaller than M5 with a dose of 75 gr/kep, which will cause excess costs for the company.

3.2 Weed growth is stunted

Observation data weed growth hampered by taro mouse with treatment application herbicide *Metsulfuron methyl* at periods of 1, 2, 3, 4 and 5 weeks after application (WAA), along with with table anova test analysis and further tests dmrt 5% level in SPSS 26 can be done seen in Appendix 14-23. Based on fingerprint data results variation obtained in the treatment method application herbicide *Methyl metsulfuron* in the period 1 MSA to 5 WAA has an effect real to weed parameters growth hampered.

Table 3. Weeds Growth Hampered with Treatment Application Herbicide *Methyl metsulfuron* in periods 1, 2, 3, 4, and 5 WAA

Treatment	Weeks After Application (WAA) %				
	1	2	3	4	5
M0	0.0b	0.0b	0.0c	0.0b	0.0d
M1	1.0a	1.0a	1.0b	1.75a	2.25c
M2	1.0a	1.0a	1.25ab	2.0a	3.25b
M3	1.0a	1.25a	1.75a	2.25a	4.0a
M4	1.0a	1.25a	1.50ab	2.25a	4.0a
M5	1.0a	1.25a	1.50ab	2.25a	4.0a

Note: Numbers followed by letters that are not the same in the same column are significantly different according to the 5% DMRT test.

Based on Table 3, the herbicide *Methyl metsulfuron* had a significant effect, namely the M3, M4, and M5 treatments in weeks 1 to 5. The best results were found at 5 WAA, with the M5 treatment (4) significantly different from the M1 treatment (2), but treatment levels M4 (4), M3 (4), and M5 (4) were not significantly different. For treatment results, the highest found in treatment M5 (4.0%) at 5 MSA, and the lowest found in treatment M1 (2) at 5 WAA. Likewise, M0 does not show obstruction growth weed. Because of course there is change. The same very to weed parameters growth hampered.

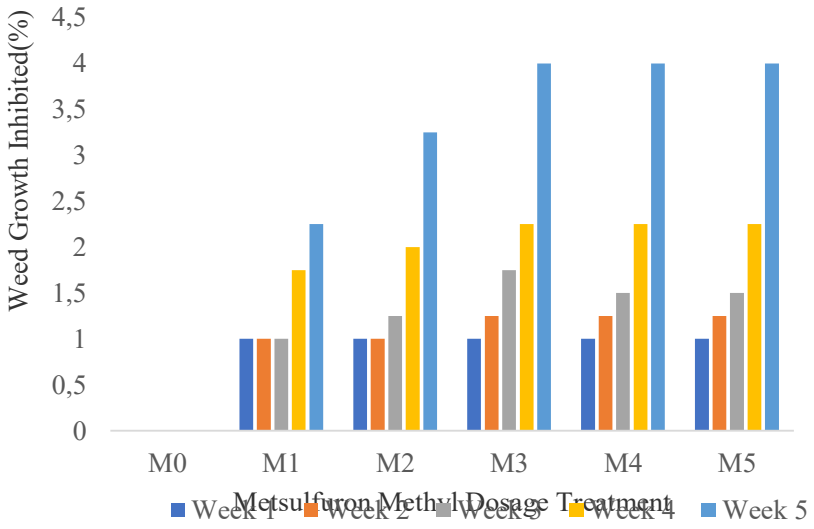

Figure 3. Weed Growth is Inhibited

Based on Figure 2, it shows the parameters of inhibited growth of weeds and the effective dose in controlling weeds in the plate and pikul markets with a dose of M1 dose of 15 gr/kep, M2 dose of 30 gr/kep, M3 dose of 45 gr/kep, and M4 dose of 60 gr/kep, as well as M5 with a dose of 75 gr/kep. This can be seen from the increase every week in each treatment; this shows that the impact of the herbicide *Methyl metsulfuron* inhibits the growth of rat taro weeds, which is seen at the time of each observation. This matters because herbicide-capable control weeds disrupt the processes of photosynthesis, respiration, germination, and protein synthesis. There is an inhibition of physiological processes, weed. Then will cause obstruction of metabolism and lowering weight weed. Herbicides are absorbed and translocated to all over the plant, so that results in weed poisoning and finally dead, increasingly tall doses applied herbicides. The more amount absorbed, the herbicide so that result emphasis on germination and growth root weed (Oksari, 2014).

3.3 Percentage of weed death

Observation data percentage death weed taro mouse (*Typhonium blumei*) with treatment application herbicide *Metsulfuron methyl* in period 5 weeks after application (WAA), along with table anova test analysis and further tests DMRT 5% level in SPSS 26 can be done as seen in Appendix 12-13. Based on fingerprint data results, variation obtained in the treatment method application herbicide *Methyl metsulfuron* in period 5 weeks after application (WAA) has an effect real to the percentage parameter death weed.

Table 4. Percentage Death Weeds on Treatment Herbicide *Metsulfuron methyl* Period 5 WAA

	Weeks After Application (%)
Treatment	5
M0	0d
M1	59c
M2	65.32bc
M3	73.8ab
M4	72.95ab
M5	77a

Note: Numbers to follow letters that don't the same in the same column different real according to the DMRT test 5%.

Based on Table 4, in fact herbicide *Metsulfuron methyl* is influential; that is, with M5 treatment in weeks 5th, results best found in 5 WAA with M5 treatment (77%) were significant with treatments M1 (59%) and M0. However, treatment levels M4 (72.95%), M3 (73.8%), and M2 (65.32%) not significant. For treatment results, the highest found in treatment M5 (77%) at 5 WAA, and the lowest found in treatment M1 (59%) at 5 WAA. Likewise, M0 does not show change. The same very to the percentage parameter death weed because, of course, without existing treatment the same very.

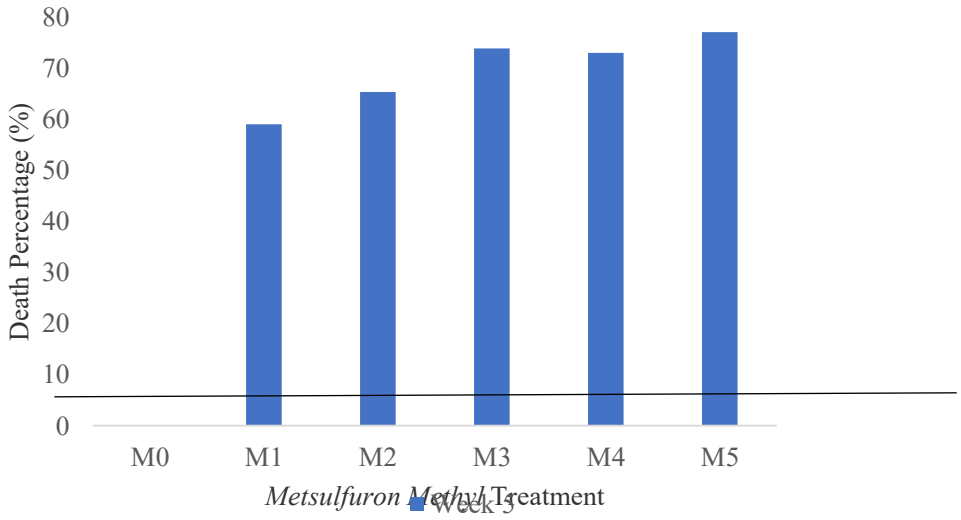

Figure 4. Percentage Death Weeds
Source: Primary Data (2024)

Based on Figure 3, the results of the average percentage parameters for death weed show that on various doses, herbicide *Metsulfuron methyl* is capable of controlling weed taro mouse. At level treatment, M5 (77%) had the ability to poison the best weed. If compared to the level M1 treatment (59%) had the lowest in poison weed. Conversely, treatment level M0 did not show any improvement in weed control, as expected, due to the absence of treatment.

Herbicides with the active ingredient metsulfuron methyl are one of the herbicides that can control weeds in oil palm plantations. Metsulfuron methyl herbicide belongs to the *Sulfonylurea family,* which works by inhibiting the action of the enzymes *acetolactate synthase* (ALS) and *acetohydroxy synthase* (AHAS). The initial mechanism of this herbicide works by inhibiting the change of *α ketoglutarate* to 2-*acetohydroxybutyrate* and *pyruvate* to 2-*acetolactate*, resulting in the branch chain amino acids valine, *leucine,* and *isoleucine* not being produced (Khasanah, 2014). Without important amino acids, protein cannot form, and plants may day.

On wide leafy weeds, especially *Typhonium blumei*, the response to application of herbicide *Metsulfuron methyl* is very slow. This is because the weed's leaf surface is coated like wax, requiring time to penetrate into the plant's cellular network. Changes in the plant's appearance, such as wilting and yellowing, can be observed several weeks after application.

Meanwhile, on narrow-leafed weeds such as *Paullinia pinata*, changes in their appearance, such as withering and drying up, are observed more quickly because they lack a protective surface layer on their leaves. This demonstrates that the application of the herbicide Metsulfuron methyl effectively inhibits weed growth. The ability of herbicide Metsulfuron methyl to control weed growth is nearly identical across different doses.

Based on the data presented in Tables 2, 3, and 4, the dose that should be used is M3 (45 gr/kep) compared to M5 (75 gr/kep). This is because the dose of 45 gr/kep (M3) can already inhibit and kill the same weeds as the 75 gr/kep (M5) treatment. The use of high doses of herbicides in the environment around the garden will have a continuous negative impact, such as soil damage (soil physical properties change) caused by herbicide residues, the death of microorganisms in the soil, loss of soil chemistry, and air and groundwater pollution, which results in disruption of health. In addition, the use of the M3 dose is more cost-effective than the M4 dose and M5 dose. In terms of integrated pest management, the use of herbicide doses should be done appropriately and is one of the last forms of control.

4. CONCLUSION

Metsulfuron-methyl significantly affected visual damage, growth inhibition and mortality rates in Typhonium blumei. At 5 WAA, the M3 treatment (45 g per backpack sprayer) resulted in 83 per cent visual damage, a growth inhibition score of 4.0 and a mortality rate of 73.8 per cent. These responses were statistically comparable to those obtained at the higher M4 and M5 rates for the key efficacy variables. Therefore, under the conditions of this study, M3 was the lowest rate tested

that provided control equivalent to the higher rates. Before this dose can be recommended for operational use, the application rate must be converted to a standard dose based on area and validated at additional sites, under different weed densities and environmental conditions, for further research.

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AUTHOR'S STATEMENT

Conflict of Interest

The authors declare that they have no conflicts of interest.

Author Contributions Hapsani

Arie Hapsani Hasan Basri (AHHB) designed the research, collected natural materials, conducted experiments, analyzed data, and wrote and revised the manuscript. Arham Jiddan (AJ) provided experimental support, data analysis, and manuscript writing. Aisar Novita (AN) completed the manuscript and supported submission to journals and revised the manuscript.

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