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VEGETATION ANALYSIS AND EFFICACY OF METSULFURON-METHYL 20% HERBICIDE TO CONTROL WEEDS IN THE SMALLHOLDER RUBBER (Hevea brasiliensis Muell. Arg.) PLANTATION IMMATURE TREE

ANALISIS VEGETASI DAN EFIKASI HERBISIDA METIL METSULFURON 20% TERHADAP GULMA DI PERKEBUNAN KARET (*Hevea brasiliensis* Muell. Arg.) YANG BELUM MENGHASILKAN MILIK RAKYAT

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ABSTRACT

Indonesia is a world's largest rubber plantation area, but it is contrary with the productivity. One aspect of cultivation that causes a decrease in rubber productivity is competition with weeds, therefore the utilization of a chemical herbicide (metsulfuron-methyl 20%) has the effective potentially to controlling weeds in rubber plantations. This study aimed to evaluate the vegetation and composition of weeds, obtain the dose of metsulfuron-methyl 20% herbicide which is effective and efficient in controlling weeds in immature smallholder rubber plantations, and aware the phytotoxicity of rubber trees due to the application of it. The present research was conducted at the smallholder rubber plantation located in Ampek Koto, Pulau Punjung District, Dharmasraya and the Laboratory of Andalas University 3rd Campus, Dharmasraya. This research was designed based on a Randomized Block Design (RBD) with seven treatments were repeated four times, i.e., metsulfuron-methyl 20% herbicide at 37,5; 50; 62,5; 75; 87,5 g/ha, manually weeding, and control plot. The observations data were analysis of variance and it was continued by Duncan's Multiple Range Test (DMRT) at 5% significance level. The results showed that there were five weed species that dominated in the immature rubber plantations, and metsulfuron-methyl 20% herbicide had an effect on two species of weeds, i.e. Borreria latifolia and Clidemia hirta, with a more effective and efficient dose of 37,5 g/ha. The results of phytotoxicity observations on immature rubber trees showed no symptoms due to application of metsulfuron-methyl 20% herbicide. It is can be as a consideration for farmers and stakeholder in using this herbicide, thus impact on supporting sustainable agriculture because the recommended herbicide dose is the lowest one.

KATA KUNCI:

Herbisida, karet TBM, metil metsulfuron, fitotoksisitas, gulma

ABSTRAK

Indonesia merupakan negara dengan luasan pertanaman karet terbesar, namun potensi tersebut tidak mendukung produktivitas yang diperoleh. Salah satu aspek budidaya yang menyebabkan turunnya produktivitas karet adalah gangguan gulma, oleh karena itu aplikasi herbisida kimiawi dengan bahan aktif metil metsulfuron 20% berpotensi untuk mengendalikan gulma di perkebunan karet. Tujuan dari penelitian ini yaitu mengetahui vegetasi gulma pada lahan perkebunan karet TBM milik rakyat, mendapatkan dosis herbisida metil metsulfuron 20% yang efektif dan efisien dalam mengendalikan gulma, dan mengevaluasi fitotoksisitas pada tanaman karet akibat aplikasi herbisida tersebut. Penelitian ini dilaksanakan di kebun karet belum menghasilkan milik rakyat yang berlokasi di Ampek Koto, Kecamatan Pulau Punjung, Kabupaten Dharmasraya dan Laboratorium Departemen Budidaya Tanaman Perkebunan, Kampus 3 Universitas Andalas, Dharmasraya. Penelitian ini dirancang berdasarkan Rancangan Acak Kelompok (RAK) dengan tujuh perlakuan yaitu herbisida metil metsulfuron 20% dosis 37,5; 50; 62,5; 75; 87,5 g/ha, penyiangan mekanis, dan kontrol. Data hasil pengamatan dianalisis ragam dan dilanjutkan dengan *Duncan's Multiple Range Test* (DMRT) pada taraf 5%. Hasil penelitian menunjukkan bahwa terdapat lima spesies gulma yang mendominasi pada lahan tanaman karet belum menghasilkan di lokasi tersebut dan herbisida metil metsulfuron 20% memberikan pengaruh terhadap dua jenis gulma yaitu *Borreria latifolia* dan *Clidemia hirta*, dengan dosis yang lebih efektif dan efisien yaitu 37,5 g/ha. Di samping itu, tidak ditemukan adanya gejala fitotoksisitas (keracunan) pada pohon karet TBM akibat perlakuan herbisida metil metsulfuron 20%. Hasil ini dapat sebagai bahan pertimbangan bagi petani dan *stakeholder* dalam menggunakan herbisida jenis ini, sehingga berdampak dalam mendukung pertanian berkelanjutan karena dosis herbisida yang direkomendasikan adalah dosis terendah.

1. INTRODUCTION

Indonesia is recorded as the country with the largest rubber plantation area in the world, reaching 3,83 million hectares. This commodity plays an important role as a foreign exchange earner because around 83,42% of Indonesia's rubber production is exported abroad. However in reality, with the potential of land area, Indonesia still in the 2nd ranks (after Thailand) as a world rubber producer (Central Agency of Statistics, 2022). This is because 85% of rubber plantations in Indonesia are smallholders that not use superior planting materials, the condition of the plants is old, and several other cultivation aspects cause the productivity level of Indonesian rubber to be relatively low, such as less fertile soil conditions, attacks by plant pests and diseases, and the presence of weeds.

Weeds in rubber plantations will be detrimental because it reduce production and disrupt management activities that can decrease the profits of plantation businesses (Purba, 2000; Guzzo et al., 2014). Weeds on immature plants as well as on produced plants can decrease the leaf area, leaves number, female flower production, dry weight, and fresh latex yield (Habibulloh *et al*., 2023).

Weed control in immature rubber plantations is important because it must be well maintained in order to produce optimally during the produced period. Weed control behavior that carried out by farmers in smallholder rubber plantations are manually, but there are some obstacles, such as requiring a long time, difficult labor and high wages. Therefore, chemical weed control with herbicides is expected to overcome those obstacles. As revealed by Anwar (2007) that some advantages of chemical weed control include being faster and easier, the garden is cleaner for longer, and requires less labor.

Based on Purba (2009), one of the herbicides that is widely available on the market and commonly used is a herbicide that contain active ingredient metsulfuron-methyl 20%. It is able to manage weeds in immature rubber plantations because it is selective for broad-leaved weeds, long-lasting control power so no need for continuous application. However, before applying the herbicide metsulfuron-methyl 20%, a vegetation analysis required to be carried out to evaluate the composition of weeds that have high ability to controlling living space and growing facilities, so that it can be determined whether the weeds are important or not. In addition, the application of chemical herbicides with the proper dosage is very important to be effective and efficient in controlling weeds, does not cause phytotoxicity to the main crops and does not have a negative effect on the soil and environment.

It is supported by Pujisiswanto *et al*. (2024) revealed that the application of metsulfuron-methyl 20% herbicide at a dose of 15 - 30 g/ha changes in weed composition, effectively controlled total weed growth, and did not cause toxicity to immature oil palm plantations. Furthermore, Pani *et al*. (2022) reported that the best dose of herbicides with metsulfuron-methyl 20% as active ingredients is 37,5 - 50 g/ha to managing weeds in juvenile oil palm plants. Hence, the present research aimed to ascertain the vegetation of weeds in smallholder immature rubber plantations, to decide an effective and efficient dosage of metsulfuron-methyl 20% herbicide on control weeds, and to determine the level of toxicity (phytotoxicity) in immature rubber trees due to the application of metsulfuron-methyl 20% herbicide.

2. MATERIALS AND METHOD

The present research was carried on three months, located at the smallholder immature rubber plantations in Tanjung Limau, Ampek Koto Village, Pulau Punjung Sub-district, Dharmasraya Regency and weed identification was conducted at the Laboratory of the Department of Estate Crops Cultivation, Andalas University the 3rd Campus.

The equipment used in this study was a knapsack capacity 15 liters, semi-automatic backpack sprayer with blue T-zet nozzle (spray volume 450-600 l/ha and pressure 1 kg/cm^2), personal protective equipment, measuring cup, funnel, analytical scale, oven, and hoe. The materials used were weeds as samples, sealed metsulfuron-methyl 20% herbicide number 424/OL/PSP/4/2017, plastic bag, kraft paper, and water as solvent.

The present research was designed based on a Randomized Block Design (RBD) consisted of seven treatments repeated four times, there were a total of 28 experimental units (plots). The seven treatments were control (without weed control), manually weeding, and application of metsulfuron-methyl 20% herbicide at a dosage of 37,5 g/ha, 50 g/ha, 62,5 g/ha, 75 g/ha, and 87,5 g/ha. The observation data were analyzed by F-test (analysis of variance) at the 5% significance level and continued by the Duncan's New Multiple Range Test (DNMRT) at 5% level if it is significantly different. Statistical analysis was performed by Statistical Tool for Agricultural Research (STAR) software version 2.0.1.

The experimental unit was a 2 m × 15 m plot (consisting of 4 immature rubber trees) in which there were 6 small plots, each sized 0,5 m × 0,5 m (quadrant) were determined systematically. At the beginning of the experiment, ensure the distribution of target weeds was evenly by arranging the treatment location and replication plots in such a way. The plot where the herbicide was applied has a minimum weed cover of 75%. Herbicide application was carried out only one time at the beginning of the experiment, in the morning when the weather was sunny and there was no rain 3 hours before and after the application.

Before herbicide application, vegetation analysis was conducted to evaluate the weed species that are dominant in the research area. It was indicated by the level of Summed Dominance Ratio (SDR) which is the average of the absolute density, absolute weeds dry weight, and absolute frequency. Furthermore, weed sampling after herbicide treatment was carried out at 4, 8, and 12 Weeks After Application (WAA). Weeds were taken at three sampling points using the quadrant method sized 0,5 m × 0,5 m. Weeds found in the quadrant plot were cut parallel to the ground surface, green weeds that still alive were separated according to their species and then dried in an oven for 48 hours at 80 ^{o}C, until weight was constant. The total weeds dry weight obtained included the dry weight of the dominant weeds, the weeds dry weight of each species, and the total weeds dry weight.

Phytotoxicity (toxicity level) was observed at 2, 4 and 6 WAA visually to the immature rubber tree population in the experimental plot. The scoring of herbicide phytotoxicity on the main crops refers to the herbicide testing standards of the Directorate of Fertilizers and Pesticides (2012) as presented in Table 1. The efficacy of the herbicides tested in this study was assessed based on statistical analysis of dry weight data (biomass) of each target weed species (maximum of five dominant weed species) and total weeds in the experimental field.

Table 1. Scoring for Herbicide Phytotoxicity Used in the Present Study.

Score	Category	Poisonous symptom
0	No poisoning	0-5 % of malformation or discoloration of young leaves
1	Light poisoning	6-10 % of abnormal form or color of young leaves
2	Medium poisoning	11-20% of abnormal form or color of young leaves
3	Hard poisoning	21-50 % of abnormal form or color of young leaves
4	Very hard poisoning	>50 % of abnormal form or color of young leaves, dry and fall

3. RESULT AND DISCUSSION

3.1 The Vegetation of Weeds

The vegetation analysis results before application of metsulfuron-methyl 20% herbicide, five species of weeds were found that dominate on the immature rubber plantation, i.e., *Brachiaria mutica*, *Asystasia gangetica*, *Passiflora foetida* L., *Commelina benghalensis*, and *C. hirta* (Table 2).

B. mutica is the most dominant narrow-leaved weeds in the experimental field with the highest SDR level of 42,69%. According to Jayadi (1991); Motooka et al. (2003), this weed is classified as a long-lived grass, can grow as a heavy expanse with a stem height of 30-45 cm, and the height of the flowering stalk be able up to 1 m. According to Schultze-Kraft (1992), *B. mutica* weeds has short rhizomes, linear leaf shape sized 10-100 cm × 3-20 mm, hairy or furry at the tips and dark green in color. Inflorescences (flowers) are purple consisting of 2-16 bunches (racemes) with a length of 4-20 cm, rachis 1 mm, spikelet length elliptical 4-6 mm, glume length one third of the spikelet length.

The second type of weed that prominent on the experimental field is *A. gangetica* with SDR level of 24,70%. *A. gangetica* or known as chinese violet is a perennial plant that grows and develops by seeds. This weed grows creeping to a height of 50-200 cm, the leaves shape is opposite and there are no stipules, the leaves are ovule-shaped with a width of 0,5-5,5 cm and a length of 2,5-16,5 cm, the length of the leaf stalk is 0,5-6,0 cm. The leaf base of young leaves exhibits a triangular inverted (cuneatus) or heart-shaped (cordatus) morphology. The leaf tip is pointed (acuminatus) and the leaf surface is pubescens (short, soft hairs). The flowers is like bells with a length of 2,0-2,5 cm, white or white with purplish spots, the flower stalk length is ± 3 mm and the flower petals length is 4-10 mm. The fruit is shaped like a capsule, include 4 seeds with a length of ± 3 cm (Palasta, 2007).

Weed reproduction is relatively simple, both vegetatively and generatively. It will grow rapidly when the growth requirements such as sunlight, water, nutrients, and other growth requirements are fulfilled. Both of the weed species that dominate at the research area have a wide distribution capacity, it can grow in tropical and subtropical areas. Therefore, the findings of this study align with Pani et al. (2022) that in immature oil palm plantations, dominant weeds from the species *B. mutica* and *A. gangetica* were also found.

Table 2. List of Weed Species were Found in Immature Rubber Plantation Areas

Weed Species	ADe (%)	AF (%)	ADo (%)	SDR (%)
Brachiaria mutica	**65,75**	**25,56**	**36,77**	**42,69**
Asystasia gangetica	**19,96**	**25,56**	**28,86**	**24,70**
Passiflora foetida L.	2,95	13,33	10,35	8,88
Commelina benghalensis	2,52	11,11	8,31	7,31
Clidemia hirta	2,08	6,67	4,32	4,35
Borreria latifolia	3,39	4,44	3,58	3,81
Axonopus fissifolius	1,97	5,56	2,21	3,25
Commelina difussa	0,66	3,33	2,62	2,20
Mikania micrantha	0,77	3,33	2,02	2,04
Mucuna bracteata DC.	0,22	1,11	0,96	0,76
Total	100	100	100	100

Note: ADe = Absolute Density, AF = Absolute Frequency, ADo = Absolute Dominance, SDR = Summed Dominance Ratio.

3.2 Efficacy of Metsulfuron-Methyl 20% Herbicide

3.2.1 Weeds with significant response

The success standard in weed control using metsulfuron-methyl 20% herbicide is the comparison of dry weight (biomass) of weeds. The results of the F-test (analysis of variance) of weeds dry weights on five dominant weed species, there were two species of weeds that provide a significant response to the application of metsulfuron-methyl 20% herbicide, namely *B. latifolia* and *C. hirta* (Figure 1).

B. latifolia is a broad-leaved weed found in the research area, the presence of this weed is not too dominant (SDR value 3,81%), but this weed gives a significant response to metsulfuron-methyl 20% herbicide. Table 3 shows the average dry weight of *B. latifolia* weeds at 4, 8, and 12 weeks after treatment of metsulfuron-methyl 20% herbicide, with manually weeding and control treatments as a comparison.

Ever since the 4th week after application, symptoms of poisoning have been seen in *B. latifolia* weeds due to the application of metsulfuron-methyl 20% herbicide, which is characterized by wilting stems, leaves starting to turn yellow and gradually turning brown as if burnt. Similar results were also reported by Saputra *et al*. (2021) that herbicides with the active ingredient metsulfuron-methyl at a dosage of 15 - 30 g/ha are effectual to controlling *Borreria alata* weeds in immature rubber cultivation. Supriyadi (2001) enhance that the herbicide with the trade name Ally 20 WG which contain the active ingredient of metsulfuron-methyl 20% is specific for broad-leaved weeds, such as *Synedrella nodiflora*, *B. latifolia*, *B. alata*, and *Ageratum conyzoides*.

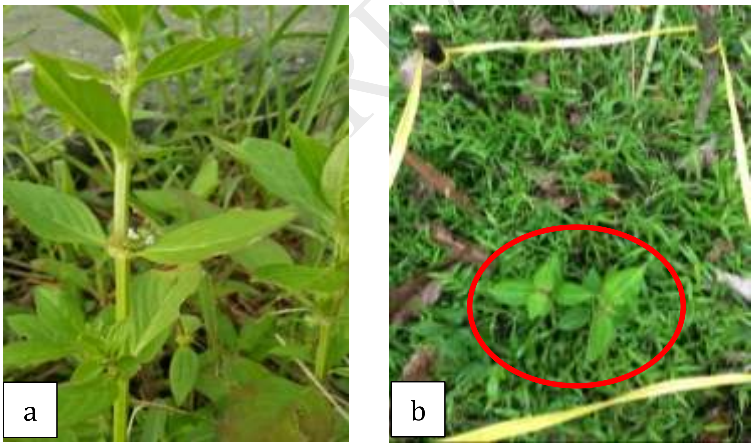

Figure 1. Weed species that exhibit a significant response. (a) *B. latifolia*: (b) *C. hirta*

Table 3. Average Dry Weight of *Borreria Latifolia* Weeds

Treatment	Dose (g/ha)	Dry Weight of *B. latifolia* (g/m^2)		
		4 WAA	8 WAA	12 WAA
Metsulfuron-methyl 20%	87,50	1,51 a	0,92 a	1,35 a
Metsulfuron-methyl 20%	75,00	2,08 ab	2,13 ab	2,12 ab
Metsulfuron-methyl 20%	62,50	3,36 bc	2,66 bc	2,41 ab
Metsulfuron-methyl 20%	50,00	4,60 cd	3,63 bc	3,15 bc
Metsulfuron-methyl 20%	37,50	5,94 de	5,52 cd	4,02 cd
Manually weeding	-	8,32 ef	7,47 ef	7,62 ef
Control (no treatment)	-	10,11 f	10,57 f	11,92 f
	CV =	18,62%	20,98%	16,82%

Note: The numbers followed by the same lowercase letters in same column indicated a not significant difference according to DNMRT at the 5% level. WAA = Weeks After Application.

The application of metsulfuron-methyl 20% herbicide at all application dosage capable to depress the dry weight of *B. latifolia* weeds until 12 WAA and and there was a significant difference with manually weeding and no treatment (control). However, when viewed in concerning of effectiveness and efficiency usage, the lowest dose of 37,5 g/ha would be more effective and efficient because although the dose of herbicide was increased, it did not cause a statistically significant decrease in the dry weight of the *B. latifolia* weeds. It is in accordance with the criteria of herbicide efficacy criteria presented by Alfredo *et al*. (2012) that a herbicide to be effective if the weed biomass in the herbicide treatment plot is lower compared to mechanical/manual weeding and control treatment.

In order to herbicides react effectively, the appropriate dose application is required, a dose too high results improvidence and cause a negatively effect to the main crops, environment and soil. In accordance with Girsang (2005); Das *et al*. (2021), the effectiveness of herbicide use to controlling weeds is determined by the level of application dose, which also affects cost efficiency (economically). Too high application dose will cause spendthrift and problems on the soil and environmental pollution, otherwise too low dose causes the goal of weed control not to be achieved.

Besides it, there are several factors that affect the effectiveness and efficiency of herbicide application, as conveyed by Barus (2003) that external factors include sunlight, wind, rainfall, air humidity, and temperature. While the internal factor is the right time to apply herbicide, when the weeds not in the generative phase (still young) because the absorption of herbicides active ingredients into the weed tissue is more effective on that phase.

Furthermore, the second species of weed that gave a significant response to the application of metsulfuron-methyl 20% herbicide was *C. hirta*. Faisal *et al*. (2011) stated that *C. hirta* is an annual herbaceous broad-leaves weeds with woody stems that completes its life cycle in years because it has strong and deep roots. Weed species of *C. hirta* is the 5th dominant vegetation in the research field with an SDR level of 4,35%. The application of herbicide containing the active ingredient metsulfuron-methyl 20% at all treatment doses affected the dry weight of *C. hirta* weeds up to 12 MSA and was significantly different when compared to manually weeding and control treatments (Table 4).

Table 4 shows that all doses of metsulfuron-methyl 20% treatment were capable to depress the dry weight of *C. hirta* weeds until 12 WAA much lower than the dry weight value of weeds in manual weeding and control treatment. Thus, in terms of effectiveness and efficiency usage, the lowest dose of 37,5 g/ha is more recommended for used. The use of low doses is more recommended in the application of herbicides in the field to avoid wasteful use, avoid phytotoxicity to plants, and to reduce the residual impact of herbicides on the soil and environment.

Table 4. Average dry weight of *Clidemia hirta* weeds

Treatment	Dose (g/ha)	Dry Weight of *C. hirta* (g/m^2)		
		4 WAA	8 WAA	12 WAA
Metsulfuron-methyl 20%	87,50	1,54 a	1,44 a	1,29 a
Metsulfuron-methyl 20%	75,00	2,70 ab	2,80 ab	2,03 ab
Metsulfuron-methyl 20%	62,50	3,66 ab	3,65 bc	3,25 bc
Metsulfuron-methyl 20%	50,00	4,73 bc	4,82 cd	4,30 cd
Metsulfuron-methyl 20%	37,50	6,12 cd	6,98 e	5,52 de
Manually weeding	-	10,12 ef	8,79 fg	7,68 fg
Control (no treatment)	-	14,80 f	11,50 g	10,50 g
	CV =	21,92%	15,08%	18,56%

Note: The numbers followed by the same lowercase letters in same column indicated a not significant difference according to DNMRT at the 5% level. WAA = Weeks After Application.

Metsulfuron-methyl 20%, starting on a dosage of 37,5 g/ha, reduced the biomass of *C. hirta*. Consequently, 37,5 g/ha is the optimal dosage. Putri *et al*. (2024) declare that the optimal herbicide dosage refers to the quantity of herbicide that effectively controls weeds while minimizing harmful impacts on crops, human health, and the environment. This approach ensures sustainable farming, working by maintaining a harmonious balance between effectiveness and safety. The inhibitory capacity of metsulfuron-methyl on the establishment of the acetolactate synthase (ALS) enzyme was correlated with a reduction in weed dry weight. The metabolism of weeds is disrupted, leading to toxicity and potentially fatal consequences. In instances of resistant weeds, inhibiting the ALS enzyme synthesis disrupts the synthesis of proteins and the transmission of photosynthetic signals, resulting in diminished weed biomass and reduced seed yield.

Metsulfuron-methyl exhibits potent herbicidal activity even at relatively low application rates. Its mechanism of action involves suppressing cell division in shoots and roots by inhibiting the ALS enzyme (Khairuddin *et al*., 2021). The ALS enzyme inhibits the conversion of pyruvate to 2-acetolactate and ketoglutarate to 2-acetohydroxybutyrate, that catalyzes the initial stage in the biosynthesis of leucine, isoleucine, and valine, which are categorized as branched-chain amino acids. Plants are unable to survive if they are deprived of these essential amino acids, as protein synthesis is obstructed (Xu *et al*., 2020). Acetolactate synthase (ALS) is an enzyme that specifically targets five types of herbicide chemical compounds, i.e., imidazolinone (IMI), pyrimidinyl-thiobenzoates (PTB), sulfonylurea (SU), sulfonylamino-carbonyl-triazolinone (SCT), and triazolopyrimidine (TP) (Ottis *et al*., 2004; Lamego *et al*., 2009).

3.2.2 Other weeds with no significant response

Herbicides with the active ingredient metsulfuron-methyl 20% are specific for controlling broad-leaves weeds (Alfredo *et al*., 2012; Saputra *et al*, 2019). Therefore, it is not show a significant effect on weeds in the research area that are included in the grass group such as *B. mutica*, *Axonopus fissifolius*, and *Commelina difussa*.

However, there were several broad-leaves weeds in the research area that did not respond significantly to the application of metsulfuron-methyl 20% herbicide, such as *Micania micrantha*, *Mucuna bracteata* DC., and *P. foetida* L. This was allegedly because the influence of high rainfall during the research, causing the herbicide solution to be washed away or the dose used was not yet able to kill the weeds. This is in accordance with the statement of Barus (2003); Kumar *et al*. (2023), that rainfall is one of the external factors that affects the effectiveness and efficiency of herbicides because it affects washing and reduces the amount of herbicide absorbed by weeds. Tomlin (2009) stated that metsulfuron-methyl 20% herbicide is absorbed through the leaves and roots which are then translocated to the plant shoots, finally weed death will be seen in the 2^{nd} - 4^{th} weeks after application.

3.3 Phytotoxicity on Immature Rubber Trees Due to Application of Metsulfuron-Methyl 20%

Observation of phytotoxicity on the immature rubber trees was conducted visually using the scoring method (Table 1) at the 2, 4, and 6 weeks after treatment of metsulfuron-methyl 20% herbicide. The scoring value obtained in all observations was 0, means that there were no symptoms of toxicity on the main crops (immature rubber trees) due to the treatment of metsulfuron-methyl 20% herbicide.

The application of metsulfuron-methyl 20% herbicide does not poison and kill cultivated crops, because this herbicide is systemic and selective which only controls certain types of weeds and not poison the rubber trees. In addition, Radosevich *et al*. (2007); Burgos & Ortuoste (2018) stated that the application of herbicides on rubber plantations at age of 3-4 years with deep roots, tall plant stem and thick bark so that the applied herbicides difficult to penetrate into the rubber plant tissue system.

4. CONCLUSION

The finding that there were five dominant weed species on immature rubber plantations, i.e., *B. mutica*, *A. gangetica*, *P. foetida* L., *C. benghalensis*, and *C. hirta*. However, the metsulfuron-methyl 20% herbicide just have an effect on two species of weeds, namely *B. latifolia* and *C. hirta*, with a recommended dose was 37,5 g/ha. Besides that, no symptoms of phytotoxicity (poisoning) were found in immature rubber trees due to the application of metsulfuron-methyl 20% herbicide. Comprehensive research is necessary to elucidate the intricate resistance mechanisms exhibited by weed species to this herbicide.

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