Research Article

Vegetation analysis and the effectiveness of methyl metsulfuron herbicide to control weeds in immature oil palm plantation

Analisis Vegetasi dan Efektifitas Herbisida Metil Metsulfuron Terhadap Gulma Pada Tanaman Kelapa Sawit Belum Menghasilkan

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Abstract: One of the obstacles faced in oil palm cultivation, especially in the immature plant phase, is weeds, weeds can inhibit oil palm growth. So that weeds require special attention during cultivation, the presence of these weeds will become competitors for oil palm plants in fulfilling nutrients, light and water. This study aims to determine the composition of the types and vegetation structure of weeds in immature oil palm plants in large plantations so that the dose of herbicide with active ingredient Methyl Metsulfuron 20% is effective in controlling weeds in immature oil palm plantations in large plantations and studying the phytotoxicity of herbicides made from 20% active Methyl Metsulfuron in immature oil palm trees in large plantations. This study used a randomized block design (RBD), which consisted of 7 levels of treatment, 5 of which used the herbicide methyl metsulfuron 20% at a dose of 87.50 g / ha, 75.00 g / ha, 62.50 g / ha, 50.00 g / ha, 37.50 g / ha. ha and 2 including mechanical and control weeding which is repeated 4 times. Data analysis was performed with the F test, followed by the DMRT test at 5% level. The results showed that there were two species of weeds that dominated the research area, namely B. mutica and A. gangetica weeds with SDR values of 33.13% and 24.73%. The application of herbicides made from 20% methyl metsulfuron as active ingredients in controlling weeds in immature oil palm plantations is able to control 2 types of weeds, namely weeds including Melastoma malabathricum, Clidemia hirta with the best dose of 50.00 g / ha and 37.50 g / ha from the first 4 weeks up to 12 Weeks After Application (MSA).

Keywords: Dose, Herbicides, Phytotoxicity, Weeds

Abstrak: Penelitian ini bertujuan untuk mengetahui komposisi jenis dan struktur vegetasi gulma pada tanaman kelapa sawit yang belum menghasilkan di perkebunan besar sehingga mengetahui dosis herbisida berbahan aktif Metil Metsulfuron 20% yang efektif mengendalikan gulma pada perkebunan kelapa sawit yang belum menghasilkan di perkebunan besar dan mempelajari fitotoksitas herbisida berbahan aktif Metil Metsulfuron 20% pada tanaman kelapa sawit yang belum menghasilkan di perkebunan besar. Penelitian ini menggunakan Rancangan Acak Kelompok (RAK), yang terdiri 7 taraf perlakuan dimana 5 diantaranya menggunakan aplikasi herbisida metil metsulfuron 20% dengan dosis 87.50 g/ha, 75.00 g/ha, 62.50 g/ha, 50.00 g/ha, 37.50 g/ha dan 2 diantaranya penyiangan mekanis dan kontrol yang diulang sebanyak 4 kali pengulangan. Analisis data dilakukan dengan uji F, dilanjutkan dengan uji DMRT taraf 5%. Hasil penelitian ditemukan sebanyak dua spesies gulma yang mendominasi dilahan penelitian yaitu gulma B. mutica dan gulma A. gangetica dengan nilai SDR yakni 33.13% dan 24.73%. aplikasi herbisida berbahan aktif metil metsulfuron 20% dalam mengendalka gulma pada areal tanaman kelapa sawit belum menghasilkan diperkebunan mampu mengendalikan 2 jenis gulma iyaitu gulma diantaranya Melastoma malabathricum, Clidemia hirta dengan dosis terbaik 50,00 g/ha dan 37.50 g/ha dari 4 minggu pertama hingga 12 Minggu Setelah Aplikasi (MSA).

Kata kunci: Dosis, Fitotoksisitas, Gulma, Herbisida

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INTRODUCTION

West Sumatra Province was one of the oil palm producing areas in Indonesia and 3 districts are centers of oil palm production, one of which was in Dharmasraya Regency. The area of oil palm plantations in Dharmasraya ranks second after the West Pasaman district. It was recorded that in 2016 the total area of large oil palm plantations in Dharmasraya Regency reached 42,439.54 Ha. Overall, the total production of oil palm in Dharmasraya reached 1,290,714 tons. One of the efforts made to improve the quality and productivity of oil palm plantations was by means of land intensification. However, one obstacle faced in land intensification was the problem of cultivation. In oil palm cultivation, one of the factors that inhibit oil palm productivity is weeds. The presence of weeds in oil palm plantations requires attention during the cultivation process. The existence of these weeds will become competitors for oil palm plants in meeting the needs of nutrients, light, and water. Several types of weeds produce secondary compounds in the form of allelopathy that can inhibit oil palm growth, especially in the immature plant phase (Sari *et al.* 2020)

Weeds interfere with the smooth work, especially fertilization. The presence of weeds in waterways in plantations will interfere with water use. Therefore, weed control is very important to do. Several weed control methods have been carried out in oil palm plantations ranging from the simplest methods such as caputing to the use of chemicals, even combining several methods at once. Disc weeding on oil palm plants manually by cutting grass in the disc with a radius of 1-1.5 meters. Weed control in oil palm plantations is carried out in two places, namely in the disc and the crossbar. Weed control in discs aims to reduce competition between the main crop and weeds and to facilitate harvesting, fertilizing and other monitoring work. Usually weed control is generally carried out if weed cover conditions have reached 30% to 50% in oil palm discs (Barus 2003). The most widely used method is the chemical method using herbicides. This method is considered more practical and profitable compared to other methods, especially when viewed in terms of the need for less manpower and relatively short implementation time

Herbicides are chemical compounds used to suppress the growth or kill weeds. Success in herbicide application is largely determined by the accuracy in choosing the type and dose of herbicide, application method, and time of application. Herbicide with active ingredient methyl metsulfuron 20% is one of the herbicides commonly used in weed control in oil palm plantations. According to Senseman (2007) the herbicide methyl metsulfuron 20% belongs to the sulfonylurea family which works by inhibiting the action of the acetolactate synthase (ALS) and acetohydroxy synthase (AHAS) enzymes. The initial mechanism of this herbicide works by inhibiting the conversion of a ketoglutarate to 2-acetohydroxybutyrate and pyruvate to 2-acetolactate so that the amino acid food chain valine, leucine, and isoleucine was not produced (Tomlin 2009). It has a long-lasting control against weeds. It was previously reported by (Koriyando *et al.* 2014) that the application of 20% methyl metsulfuron was effective for controlling weeds in immature oil palm plantations. This study aims to determine the composition of the types and vegetation structure of weeds in immature oil palm plants in large plantations so that the dose of herbicide with active ingredient Methyl Metsulfuron 20% is effective in controlling weeds in immature oil palm plantations in large plantations and studying the phytotoxicity of herbicides made from 20% active Methyl Metsulfuron in immature oil palm trees in large plantations.

MATERIALS AND METHODS

This research has been carried out at PT. West Sumatra Andalas Kencana (SAK), which is located in Kenagarian Sopan Jaya, Padang Laweh District, Dharmasraya Regency, West Sumatra Province. Identification of weed species in the research location was carried out at the Laboratory of Campus III Andalas University in Dharmasraya. The study was conducted from June to September 2019. This study was arranged using a Randomized Block Design (RBD) consisting of 7 treatments and 4 replications so that there were 28 experimental plot units. The experimental plot unit was a plot of land measuring 2 m x 15 m in which there were 6 plots measuring 0.5 m x 0.5 m. The observations obtained were analyzed statistically with the F test of variance at the 5% level. If the calculated F is greater than the F table 5%, then it is continued with Duncan's New Multiple Range Test (DNMRT) at the 5% level. The treatments tested in this study were several doses of herbicide with the active ingredient of methyl metsulfuron 20%. Treatments were doses of methyl metsulfuron 20% herbicide namely 37.50 g/ha, 50.00 g/ha, 62.50 g/ha, 75.00 g/ha, 87.50 g/ha, mechanical control, and unweeded or control.

The experimental plot was made on an area of 1 ha, where on the stretch of land there were oil palm plants with a spacing of 9 x 9 meters, the age of the oil palm plants was 2 years. On the land, an experimental plot was made on the oil palm plantation with a size of 2 m x 15 m as many as 28 plots. The distance between the experimental plots is 7 meters. In each experimental plot, 6 experimental plots were made with a size of 0.5 m x 0.5 m for sampling observations. Labeling was carried out after making the experimental plots to facilitate herbicide application and observation. As well as sampling the analysis of vegetation, and weed biomass sampling.

Vegetation analysis was carried out before and after herbicide application to determine the dominant weed species in the experimental land. Dominant weed species are indicated by the value of Sum Dominance Ratio (SDR) in % in the experimental area. Vegetation analysis was carried out using the quadrant method measuring 0.5 m x 0.5 m in each experimental plot. This was done by taking all species of weeds contained in the experimental sub-plots by pulling them out. All the collected weeds are then separated by species. To ensure the species of weed then continued to be identified in the laboratory. At the same time, the number of weeds was calculated by species. After that, weed samples were wrapped using peanut paper based on species and oven for 48 hours at 80ºC.

Herbicides to be used are brought to the laboratory to be weighed according to the dose of each treatment. Weighing is done using an analytical balance. Herbicides that have been weighed are stored in plastic and labeled according to treatment. At the research location, the herbicide was dissolved in water using a bucket and stirred so that it was completely dissolved so that there was no blockage in the sprayer and nozzle channels when spraying in the research area. The spray solution is then put into a 16 liter capacity sprayer (500 l/ha). The same is done for all treatments in turn. Prior to application, weather observations were made, so that the herbicide was not washed off by rain water after application. Herbicide application must be done using Personal Protective Equipment (PPE) and applied in the morning.

Phytotoxicity observations were carried out on oil palm plants at 2, 6, and 8 weeks after application. This was done to determine the effect of herbicide application. Biomass sampling was carried out after applying herbicides at 4, 8 and 12 weeks after application. At each observation time, observations were made in two experimental subplots. Then 4 after application the observation was also carried out in two experimental subplots. The same observation was done at the 8th week after application. Observations were made on all living and growing weeds after herbicide application. Then the weeds taken from the plots were brought to the laboratory to be oven-dried for ± 48 hours at a temperature of 80ºC to determine their dry weight.

RESULTS AND DISCUSSION

Weed Vegetation on Large Plantation

Based on the results of the vegetation analysis before the application of the herbicide Methyl metsulfuron 20%, two dominant weed species were found namely from the grass weed group *B. mutica* with an SDR value of 33.13% and *Asystasia gangetica* with an SDR value of 24.73%, this weed belongs to the broadleaf group (Table 1).

Table 1. Weeds found in Oil Palm Plantation

Weed species	*RD (%)	RF (%)	RDW (%)	SDR (%)
Brachiaria mutica	45.28	21.19	32.94	33.13
Pogonatherum crinitum	5.02	10.17	5.31	6.83
Melastoma malabathricum	8.96	11.02	9.80	9.93
Asystasia gangetica	24.13	21.19	28.86	24.73
Clidemia hirta	6.33	10.17	5.12	7.21
Eleusine indica	1.08	3.39	2.89	2.45
Cyperus rotundus	0.84	424	1.30	2.13
Mikania micrantha	4.66	8.47	9.64	7.59
Dicranopteris linearis	.27	6.78	2.29	3.78
Nephrolepis biserrata	1.43	3.39	1.86	2.23
Total	100	100	100	100

* Information : Relative Density (RD), Relative Frequency (RF), Relative Dry Weight (RDW)

The dominance of *B. mutica* weeds at the research site was due to the high adaptability of weeds, this weed is able to grow quite rapidly in oil palm plantations. High weed development can be influenced by the ability of weeds to reproduce stolon and seed and generatively, one of which is by generative with the seeds produced. In addition, the spread of weed seeds supported by the environment such as water, wind, animals and humans causes weed regeneration to accelerate so that weed growth tends to increase (Mokoagow dan Fadwiwati 2012). In addition, *B. mutica* can also propagate vegetatively which triggers an increase in weed growth. Weeds are fast growing plants and can produce a large number of seeds in a short time, weed breeding is very easy both generatively and vegetatively. Weeds will develop quickly if factors such as light, nutrients, water and a place to live can be fulfilled optimally (Khasanah *et al.* 2017). Co dominace weed that dominates the research area is *A. gangetica* with an SDR value of 24.73%.

B. mutica weed is a gresses weed parennial belonging to the grass weed class *B. mutica* is a long-lived grass, growing to form a dense expanse. *B. mutica* is difficult to control mechanically because *B. mutica* has many roots for its development in cultivated land. This weed grows a lot in the area of immature oil palm plantations by spreading to form dense expanses and is difficult to control. According to Alfredo *et al.* (2013) that *B. mutica* grows semi-erect to erect (prostate/semierect-erect), is a long-lived grass, grows to form a dense expanse, the height of the stretch can reach 30-45 cm and the flowering stalk can reach a height of 1 m. Linear leaf shape is usually 10 - 100 cm x 3-20 mm, hairy or hairy and dark green. Inflorescence (flowers) consists of 2-16 bunches (racemes) 4-20 cm long, spikelets in a row; rachis 1 mm wide, purple, elliptical spikelet 4 -6 mm long, hairy or hairy at the tip, glume length one third of spikelet length.

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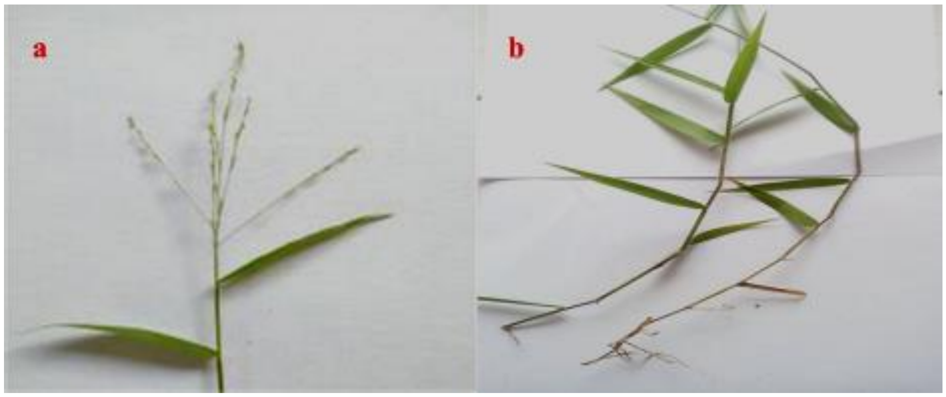

Figure 1. Weed *B. Mutica*, (a) flowers, (b) stems and leaves

The second weed that dominates the research area was *A. gangetica* with an SDR value of 24.73%, *A. gangetica* is an annual weed that grows vines and branches, the stem is rectangular with a length of up to 2 meters. The leaves are opposite in shape and there are no stipules. The petiole is 0.5-6 cm long with ovate-shaped leaves 4-9 cm long and 2-5 cm wide (Figure 2). Leaf base form triangular breech (*Cuneatus*) or heart-shaped (*Cordatus*) when the leaves are still small. The tip of the leaf is tapered (*Acuminatus*) and the surface of the leaf is short and soft (*Pubescens*). The flower stalks are up to 3 mm long and the petals are 4-10 mm long.

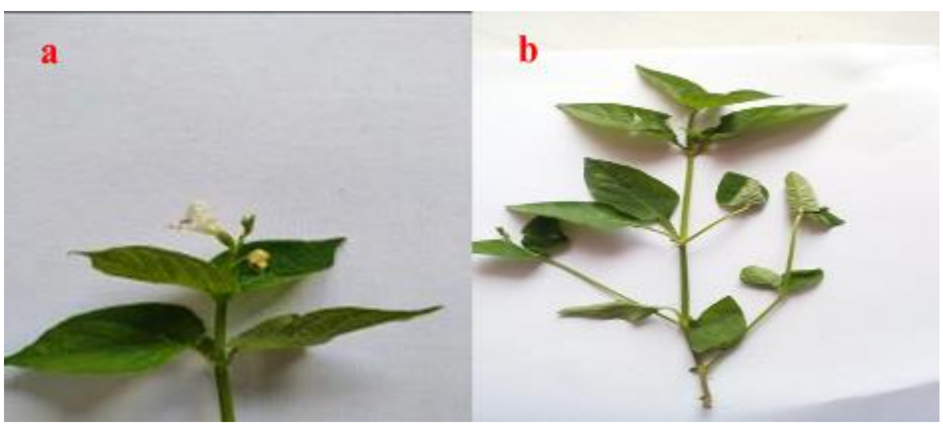

Figure 2. Weed *A. gangetica* (a) flowers, (b) stems and leaves

Flowers were usually white or white with purplish spots (Suarna *et al.* 2019). This weed can develop and grow through seeds, *A. gangetica* was a broadleaf weed that spreads through seeds. The majority of broadleaf weeds have a photosynthetic pathway. *A. gangetica* or (Chinese Violet) was a perennial plant that grows to a height of 50 cm. The leaves are oval and sometimes almost triangular in shape with a length of 2.5-16.5 cm and a width of 0.5-5.5 cm (Herilimiansyah *et al.* 2019). The stems and leaves were downy, the flowers are white or purple, and the shape resembles a bell with a length of 2-2.5 cm. The fruit is like a capsule, contains four seeds and is about 3 cm long. Can grow in tropical and subtropical areas (Kumalasari *et al.* 2019).

Weeds Affected by Herbicide

1. Melastoma malabathricum

M. malabathricum belongs to the broad-leaved weed group, have deep and strong roots so that it is difficult to control mechanically by pulling or using machines because this weed has woody stems. This weed did not dominate in the research area where the SDR value before the application of the herbicide Methyl metsulfuron obtained was only 9.93%, but after the application of Methyl metsulfuron 20% was able to suppress the growth of this weed and had an effect on the dry weight from the first 4 weeks until 12 weeks after the application of the herbicide Methyl metsulfuron 20%, each treatment dose of herbicide was significantly different from the mechanical weeding treatment and the control can be seen in Table 2.

Table 2. Dry Weight of *M. malabathricum*

Herbicide Dose *Methil metsulfuron* (20%)	Weeks After Application (g/m^2)		
	4	8	12
87.50 g/ha	0.71 d	0.71 e	0.71 c
75.00 g/ha	0.85 d	0.71 e	1.00 c
62.50 g/ha	0.71 d	0.84 de	1.13 c
50.00 g/ha	1.02 cd	1.17 d	1.09 c
37.50 g/ha	1.56 bc	1.58 c	1.73 b
Mechanical control	1.80 b	2.00 b	1.99 b
Without control	3.13 a	2.70 a	.,75 a
CV	28.87%	17.29%	23.86%

Numbers in the same column and followed by the same letters are not significantly different at the 5% level of the test DNMRT

The application of the herbicide methyl metsulfuron 20% had an effect on *M. malabathricum* weed, where there was a change in the color of the leaves, stems and shoots that began to dry. According to (Tomlin 2009) the initial mechanism of this herbicide works by inhibiting the conversion of alpha-ketoglutarate to 2-acetohydroxybutyrate and pyruvate to 2-acetolactate, resulting in the absence of branched-chain amino acids valine, leucine, and isoleucine (Purba dan Hari 2020).

In Table 2, the herbicide treatment of Methyl metsulfuron 20% was able to suppress the dry weight of the weed *M. malabathricum* at a dose of 50.00 g/ha and significantly different from the mechanical weeding and control treatments, indicating that at a dose of 50.00 g/ha the herbicide was able to control weeds up to 12 weeks after application. Methyl metsulfuron 20% herbicide treatment had a significant effect on weed dry weight in mechanical weeding and control treatments up to 12 weeks after application. According to (Budu *et al.* 2014), at 2 and 4 weeks after application the herbicide methyl metsulfuron 50.00 g/ha was able to suppress or control weed growth because the herbicide had been absorbed and translocated to plant tissues.

Figure 3. *M. Malabathricum* a) Stems and leaves, b) roots, c) symptoms of poisoning

2. *Clidemia hirta*

C. hirta weeds are broad-leaved and woody weeds that have deep roots. This type of weed did not dominate in the study area with an SDR value of 7.21%, after the application of herbicide with the active ingredient Methyl metsulfuron 20% had a significant effect on the unweeded or control treatment and mechanical weeding (Table 3).

Table 3. Dry Weight of *Clidemia hirta*

Herbicide Dose *Methil metsulfuron* (20%)	Weeks After Application (g/m^2)		
	4	8	12
87.50 g/ha	0.71 c	0.71 d	0.71 d
75.00 g/ha	0.84 c	0.85 cd	0.84 d
62.50 g/ha	0.71 c	0.87 cd	1.17 cd
50.00 g/ha	1.06 bc	1.10 bcd	1.29 cd
37.50 g/ha	0.82 c	1.30 bc	1.45 bc
Mechanical control	1.51 b	1.58 b	1.89 b
Without control	2.85 a	2.32 a	2.53 a
CV	26.23%	25.00%	26.11%

Numbers in the same column and followed by the same letters are not significantly different at the 5% level of the test DNMRT

Weed *C. hirta* can be found in plantation areas, especially in oil palm plantations. The presence of this weed in immature oil palm plantations is very disturbing for cultivated plants because it can inhibit the growth of cultivated plants and also interfere with fertilization, resulting in competition in the absorption of the fertilizer. If this weed grows in immature oil palm plantations, it will be very disturbing to cultivated plants and difficult to control. This weed is very difficult to control because it is a woody plant and has strong roots. This weed is not suitable if it is controlled mechanically or removed by hands because it has a strong root system, hard stems and when cut or pruned new shoots will appear (Satriawan dan Fuady 2019).

In Table 3, the herbicide treatment of Methyl metsulfuron 20% was able to suppress the dry weight of *Clidemia hirta* 4 to 12 weeks after application and was significantly different from mechanical weeding and control treatments. Methyl metsulfuron 20% herbicide treatment was effective to suppress dry weight of thisa weed at a dose of 37.50 g/ha to 12 weeks after application, because the dose treatment was significantly different from the control treatment. With this treatment, the herbicide Methyl metsulfuron 20% at all doses was able to suppress the dry weight of the weeds to remain below the dry weight of mechanical weeding and control treatments. According to (Koriyando *et al.* 2014) that at various doses of the herbicide Methyl metsulfuron was able to control the related weeds up to 12 weeks after application indicated by the total dry weight of the weeds was lower than the control and mechanical.

Figure 4. Weed *C. hirta* (a) roots (b) stems and leaves (c) symptoms of poisoning

Weeds Not Affected by Herbicides

Methyl metsulfuron 20% herbicide was effective in controlling weeds, especially broadleaf weeds. Therefore, out of 10 weeds identified in the analysis, the application of 20% Methyl metsulfuron herbicide was only able to control two types of broad-leaved weeds such as *M. malabathricum* and *C. hirta*. However, there are some weeds that are not affected by the application of the herbicide Methyl metsulfuron 20%, due to the ineffectiveness of the herbicide with the active ingredient of Methyl metsulfuron 20% on these weeds or the dose of herbicide applied to weeds has not been able to kill narrow-leaf weeds because it is more effective on broad-leaved weeds. It can be seen from the physical condition of the weed that does not show any effect. This is because the herbicide tested tends to be able to control broadleaf weeds than grass weeds. As stated by (Tomlin (2009) that Methyl metsulfuron can control broadleaf weeds.

Phytotoxicity Observation

The results of observations made in the research field visually at 2, 6, and 8 weeks after the application of the herbicide methyl metsulfuron 20% showed that the herbicide used did not cause poisoning in the young leaves of oil palm plants. All herbicide dose treatments gave a value of 0. This situation was indicated by the absence of symptoms of changes that occurred in the young leaves of oil palm plants. Based on Ruzlan dan Hamdani (2020) that the effectiveness of giving herbicides is determined, among others, by the dose and time of application. The right dose of herbicide will kill the target weeds, but if the herbicide dose is too high it can damage or even kill the cultivated plants.

CONCLUSIONS

Two weed species were found that dominate the research area, namely *B. mutica* and *A. gangetica*. The herbicide methyl metsulfuron 20% with a dose of 37.50 g/ha can suppress the growth of *C hirta*. Meanwhile, at a dose of 50.00 g/ha it was able to suppress the growth of M malabathricum. The application of herbicides with the active ingredient of Methyl Metsulfuron 20% does not cause poisoning to oil palm.

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