Injuruty: Interdiciplinary Journal and Humanity
Volume 2, Number 10, October 2023
e-ISSN: 2963-4113 and p-ISSN: 2963-3397

THE EFFECT OF DOSE HERBICIDE ACTIVE INGREDIENT *METSULFURON METHYL* ON WEED CONTROL, GROWTH AND YIELD OF RICE PLANTS (*ORYZA SATIVA* L.) INPARI 32 CULTIVAR

Lestari Handayani, Yuni Kurniasari, Alfian Abdurrahman Asysyafaat, Basyir Hambali, Deden, and Dodi Budirokhman
Faculty of Agriculture Gunung Jati Swadaya University, Indonesia
Email: deden@ugj.ac.id

Abstract

Rice (*Oryza sativa* L) is a food crop commodity that has a major role in the development of agriculture and the main food of the Indonesian people. Rice is a rice-producing crop. Rice (*Oryza sativa* L) is a food crop commodity that has a major role in the development of agriculture and the main food of the Indonesian people. Rice yield loss due to weeds is estimated at 10 to 15%, even up to 86% without control. The purpose of the study was to determine the effect of herbicide dosage levels and obtain the best dose of the active ingredient *Metsulfuron methyl* on weed control and rice crop yield (*Oryza sativa* L.). The experimental method used was an experimental method using Group Randomized Design (RAK) consisting of 7 experimental units and repeated 4 times, so that 28 experimental plots were obtained. The experimental treatment was A (*Metsulfuron methyl* 15 g / ha, B (*Metsulfuron methyl* 20 g / ha), C (*Metsulfuron methyl* 25 g / ha), D (*Metsulfuron methyl* 30 g / ha), E (*Metsulfuron methyl* 35 g / ha), F (manual control) and G (control). The results showed that herbicides made from *Metsulfuron methyl* with doses of 15 g / ha – 35 g / ha had an influence on the population growth of rice weed species such as *Cyperus iria*, *Fimbristylis miliacea* and *Leptochloa chinensis*. Herbicide with active ingredient *Metsulfuron methyl* does not have a toxic effect on rice plants. *Metsulfuron methyl* with a treatment dose range from 15 g / ha – 35 g / ha has a significant effect on rice weed control when compared to control treatment. The dose of *Metsulfuron methyl* is significantly different when compared to all dose levels tested and is able to produce dry rice grain as much as 14.21 kg / plot or equivalent to 11,3 tons / hectare.

Keywords: rice, weed, metsulfuron methyl, herbicide

INTRODUCTION

Rice (*Oryza sativa L.)* is a food crop commodity that has a major role in the development of agriculture and the main food of the Indonesian people. Rice is a rice-producing crop. Rice is the staple food of all levels of society, both rich and poor, rice nutrition and nutrition are relatively superior compared to other foods, the energy content reaches 360 calories per 100g, rice is a good source of protein with a protein content of 6.8g per 100g (Sufardi et al., 2011). Based on the results of the BPS survey (2022), the rice harvest pattern in Indonesia in 2022 is generally almost similar to the rice harvest pattern in 2021. In line with conditions in 2021, the peak rice harvest in 2022 will occur in March, while the lowest harvest area will occur in December. The total rice harvest area in 2022 is 10.45 million hectares, with the highest harvest area in March at 1.76 million hectares and the lowest harvest area in December, which is around 0.36 million hectares. When compared to 2021, the 2022 rice harvest area increased by 40.87 thousand hectares (0.39 percent) (Directorate of Food Crop Statistics, Horticulture, 2022). Efforts to increase production are also directed to achieve food self-sufficiency in a sustainable manner, but there are still a number of obstacles that need to be resolved. These obstacles include cultivation techniques that are not optimal. According to (Zaini, 2008), One of the causes of rice productivity in rice fields is the ineffective control of PPO (Plant Pest Organisms), one of which is the presence of weeds.

Weeds are nuisance plants that can reduce rice production if not controlled effectively (Simanjuntak *et al.*, 2016). According to (Antralina, 2012) Weeds are one of the limiting factors for rice crop production, because weeds can absorb nutrients and water faster than staple crops. Weeds are one of the biotic factors that cause yield loss, with weeds in an agricultural land (Sembodo, 2010). Yield loss due to weeds worldwide is estimated at 10 to 15%, even yield loss can reach 86% without weed control. Yield loss can be reduced by weed control (Zarwazi *et al.*, 2016). Herbicides are chemicals used by farmers to control and prevent weed growth that can be applied before planting rice and after. Herbicides with the active ingredient *Metsulfuron methyl* are more often used to suppress weed populations in rice fields. Single *Metsulfuron methyl* at doses of 12 to 16 g/ha was able to suppress per total weed plant up to 8 WAA (Alfredo *et al.*, 2018)

The purpose of this study was to determine the effect of the dose level of the herbicide active ingredient *Metsulfuron methyl* on the growth of rice plants *(Oryza sativa L.)* and to find out the dose of herbicide of the active ingredient *Meitsulfuron methyl* which has the best influence on the growth and yield of rice plants.

RESEARCH METHOD

This experiment was carried out in Cempaka Village, Kedawung District, Cirebon Regency, with an area height of ±5 meters above sea level. The experiment will be carried out for 3 months, starting from June to August 2023. The materials used in this experiment were Inpari 32 cultivar rice seeds, Urea, TSP, KCL, herbicides made from *Metsulfuron methyl*, and other ingredients that supported this experiment. The tools used in this experiment include digital scales, meters, sprayers, ovens, measuring cups, labeled bamboo, cameras and other supporting devices. The experimental method used was an experimental method using Randomized Group Design (RGD) consisting of 7 experimental units and repeated 4 times, so that 28 experimental plots were obtained.
The herbicide dosage treatment of the active ingredient *Metsulfuron methyl* tested is:
A: Active ingredient *Metsulfuron methyl* 15 g/ha
B: Active ingredient *Metsulfuron methyl* 20 g/ha
C: Active ingredient *Metsulfuron methyl* 25 g/ha
D: Active ingredient *Metsulfuron methyl* 30 g/ha
E: Active ingredient *Metsulfuron methyl* 35 g/ha
F: Manual control
G: Control (Without treatment)

The implementation of experiments in the field includes seedling preparation, tillage, planting, maintenance and harvesting activities. Herbicide application is carried out at the age of 14 Days After Moving Planting (DAMP), manual weeding is carried out 2 times according to the general treatment of farmers. Observation of weeds was carried out 2 times, namely at 3 weeks after application (WAA) and 6 WAA. To determine the effect of *Metsulfuron methyl* herbicide on rice plants, supporting observations and main observations were made. Supporting observations include rainfall data, soil analysis results and pest and disease attacks. Key observations include phytotoxicity, plant height (cm), Weed population per plot, Number of tillers, Number of panicles, Weed wet weight (g), Weed dry weight (g). Plant growth and yield data were analyzed using the RGD linear model with factorial patterns (Wijaya, 2018). If there is a significant difference from the treatment or the F-count value is greater than the F-table at the level of 5%, then the test is continued using the Duncan Test.

Weed Observation

Sample data of weed biomass in each unit of treatment plot were observed as many as two squared plots measuring 0.5 x 0.5 m. The location of the squared plot was determined systematically. Weed observation before application is carried out by sampling weeds for biomass data density and frequency data carried out before herbicide application, aiming to analyze vegetation using the summed dominant ratio (SDR). Observation of weeds after herbicide application is carried out by means of weed sampling after herbicide application. Weed sampling for the biomass of each species was carried out at 3 and 6 weeks after application (WAA). Examples of weeds taken are target weeds that are the target of the herbicide tested. Fresh weed samples were taken, then separated from each species. Then the weeds are dried in the oven at 80ºC for 48 hours or until they reach a constant dry weight, then weighed.

Phytotoxicity

The degree of poisoning is visually assessed against the plant population in the yam plot. Phytotoxicity was observed at 1, 2 and 3 weeks after the application of the herbicide. Poisoning score is 0 (no poisoning 0 – 5% leaf shape or leaf color and abnormal plant growth), 1, (mild poisoning, > 5 – 20% leaf shape or leaf color and abnormal plant growth), 2 (moderate poisoning, > 20 – 50% leaf shape or leaf color and abnormal plant growth), 3 (severe poisoning, > 50 – 75% leaf shape or leaf color and abnormal plant growth), 4 (very severe poisoning, > 75% leaf shape or leaf color and abnormal plant growth until the plant dies).

Plant Height

Plant height was measured from above ground level to the highest leaves with 10 plants randomly taken, observations were made at the age of 3 and 6 WAA.

Number of saplings

The number of saplings is calculated all saplings that grow normally. Observations were made on 10 randomly taken plant samples.

Rice yield

Observation of dry grain yields harvested in rice fields was carried out plots measuring 1m x 1m.

Efficacy Criteria

Efficacy criteria are standard conclusions from research results, while the efficacy criteria parameters are as follows:

1. Weed biomass in herbicide treatment was relatively the same as manual weeding and markedly milder than controls.
2. Can control weeds up to 6 weeks after application.

Phytotoxicity in light plants, growth in plants is good, and relative yield is the same as manual weeding treatment.

RESULT AND DISCUSSION

The composition of weeds before application

Before the application of herbicides, the diversity of weed vegetation in rice plant areas was observed, while the results of population diversity can be seen in Table 1 below:

Table 1. The effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Weed Vegetation Analysis Before Herbicide (%)

Name Spesies	***SDR (%)***
Cyperus iria	*27,26*
Fimbristylis miliacea	*20,18*
Leptochloa chinensis	*14,03*
Monochoria vaginalis	*11,04*
Ludwigia octovalvis	*10,76*
Limnocharis flava	*9,40*
Echinochloa crus-galli	*7,33*

In Table 1. Showing the results of weed vegetation analysis at the test site before being treated where the weeds that dominated the land were *Cyperus iria with* an SDR value of 27.26%, *Fimbristylis miliacea* with an SDR of 20.18%, *Leptochloa chinensis* with an SDR value of 14.03%, *Monochoria vaginalis* with an SDR of 11.04%, *Ludwigia octovalvis* with an SDR *of 10.76 %, Limnocharis flava* with an SDR of 9.40% and *Echinochloa crus-galli* 7.33%.

Dry Weight of Weeds After Application

Dry Weight of *Cyperus iria* Weed

The results of the dry weight analysis of *Cyperus iria* weeds can be seen in Table 2. Shows that the treatment of the active ingredient of the herbicide *Metsulfuron methyl* has no noticeable effect on the dry weight yield of weeds in rice crops. observation age 3 and 6 WAA.

Table 2. The effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Average Dry Weight of *Cyperus iria* Weed (g)

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	6 WAA
A.	*Metsulfuron methyl*	15	0,31 a	0,76 a
B.	*Metsulfuron methyl*	20	0,10 a	0,60 a
C.	*Metsulfuron methyl*	25	0,69 a	0,22 a
D.	*Metsulfuron methyl*	30	0,10 a	0,24 a
E.	*Metsulfuron methyl*	35	0,75 a	0,79 a
F.	Manual control	-	0,89 a	0,71 a
G.	Control (Without treatment)	-	1,19 a	0,84 a

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Based on the data in the table above, it can be seen that all dose levels of treatment of the active ingredient of the herbicide *Metsulfuron methyl* did not show significantly different results when compared to the control *Cyperus iria* weeds growing on rice plants. This indicates that the active ingredient of the herbicide *Metsulfuron methyl* has not been able to suppress the growth of weeds, especially *Cyperus iria* until the age of rice enters the generative period. This is according to the statement Edyson *et al.*, (2022), explained that the herbicide made from the active ingredient *Metsulfuron methyl* has a fairly good effectiveness in controlling grass weeds, but this does not apply to the weeds of the puzzle group.

Dry Weight of *Fimbristylis miliacea* Weed

The results of dry weight analysis of *Fimbristylis miliacea* weed *in* Table 3. showed that all dose-level treatments of the herbicide active ingredient *Metsulfuron methyl* 15 g/ha to 25g/ha in observations 3 and 6 WAA showed a marked difference when compared to controls.

Table 3. The effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Average Dry Weight of *Fimbristylis miliacea* Weed (g)

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	6 WAA
A.	*Metsulfuron methyl*	15	0,92 a	0,35 a
B.	*Metsulfuron methyl*	20	0,69 a	0,19 a
C.	*Metsulfuron methyl*	25	1,04 a	0,34 a
D.	*Metsulfuron methyl*	30	0,19 a	0,40 a
E.	*Metsulfuron methyl*	35	0,53 a	0,61 a
F.	Manual control	-	1,93 b	1,87 b
G.	Control (Without treatment)	-	0,86 a	2,47 c

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Treatment of *Metsulfuron methyl* herbicide at all concentration levels tested had a significant effect in controlling the type of *Fimbristylis miliacea* weed or can be concluded to be able to suppress the growth of *Fimbristylis miliacea* weeds, according to (Umiyati, Sumekar, 2017) showed that application treatment of various doses of the herbicide *Metsulfuron methyl* had no statistical effect on the dry weight of the weed *Fimbristylis miliacea.*

Dry Weight of *Leptochloa chinensis* Weed

Analysis of dry weight data of *Leptochloa chinensis* weed is shown in Table 3. showed that at 3 WAA and 6 WAA observations, dose-level treatment of *Metsulfuron methyl* herbicide had no significant effect on dry weight of *Leptochloa chinensis* pupulation at 3 WAA observations, but had a significant effect on 6 WAA age observations when compared to control treatment (Table 4).

Table 4. The effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on average Dry Weight of *Leptochloa chinensis* Weed (g)

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	**6 WAA**
A.	*Metsulfuron methyl*	15	0,51 a	0,58 a
B.	*Metsulfuron methyl*	20	1,51 a	0,89 a
C.	*Metsulfuron methyl*	25	0,97 a	0,58 a
D.	*Metsulfuron methyl*	30	0,86 a	0,09 a
E.	*Metsulfuron methyl*	35	0,68 a	0,75 a
F.	Manual control	-	0,91 a	0,90 a
G.	Control (Without treatment)	-	1,48 a	1,54 b

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Based on the results in table 4, it can be said that the herbicide *Metsulfuron methyl* is able to control the grass weed *Leptochloa chinensis* up to plant age 6 WAA. These results are in line with the opinion of Dwi *et al*., 2019, which states that the herbicide *Metsulfuron methyl* has proven effective in controlling *Leptochloa chinensis* weeds.

Total Weed Dry Weight

The results showed that the dose level of the herbicide active ingredient *Metsulfuron methyl* had a significant effect on total weed dry weight in observations of 3 and 6 WAA in rice fields when compared to manual weeding and control treatment (Table 5).

Table 5. The effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Average Total Weed Dry Weight on Rice Plant (g)

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	**6 WAA**
A.	*Metsulfuron methyl*	15	0,69 a	1,08 a
B.	*Metsulfuron methyl*	20	1,21 a	1,05 a
C.	*Metsulfuron methyl*	25	0,95 a	1,31 a
D.	*Metsulfuron methyl*	30	0,83 a	0,65 a
E.	*Metsulfuron methyl*	35	0,72 a	1,03 a
F.	Manual control	-	1,46 b	1,78 b
G.	Control (Without treatment)	-	2,11 c	2,45 c

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Table 5, which shows that all dose treatment levels of *Metsulfuron methyl* herbicide between doses of 15 g/ha to 35 g/ha were able to control weeds up to 6 WAA age. It can be said that the total dry weight yield of weeds is affected by the given herbicide treatment. Based on the type of weed controlled, a single *Metsulfuron methyl* herbicide showed control activity against weeds (Purba and Priwiratama, 2020), So that weeds on rice fields can be controlled properly.

Phytotoxicity of Rice Plants

Based on the test results, it is known that the use of herbicides with active ingredients *Metsulfuron methyl* between doses of 15 g / ha - 35 g / ha does not cause symptoms of poisoning in rice plants at the observation of 1-3 WAA (Table 6).

Table 6. The Effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Phytotoxicity on rice plant (%)

No.	Treatment	Dosis (g/ha)	Observation		
			1 WAA	2 WAA	3 WAA
A.	*Metsulfuron methyl*	15	0,00 a	0,00 a	0,00 a
B.	*Metsulfuron methyl*	20	0,00 a	0,00 a	0,00 a
C.	*Metsulfuron methyl*	25	0,00 a	0,00 a	0,00 a
D.	*Metsulfuron methyl*	30	0,00 a	0,00 a	0,00 a
E.	*Metsulfuron methyl*	35	0,00 a	0,00 a	0,00 a
F.	Manual control	-	0,00 a	0,00 a	0,00 a
G.	Control (Without treatment)	-	0,00 a	0,00 a	0,00 a

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Herbicide *Metsulfuron methyl* is a systemic herbicide and is selective, this herbicide only controls weeds by suppressing the growth of weeds around rice plants and does not have a poisoning effect, so that rice plants are not poisoned by herbicides made from *Metsulfuron methyl* according to Rahayu (1992) in (Alfredo et al., 2018) states that the herbicide *Metsulfuron methyl* does not affect the growth of rice plants so it is likely that *Metsulfuron methyl* also does not affect plant growth .

Growth and Yield Components

Plant Height (cm)

Table 7, shows the average height of rice plants at the age of 3 and 6 WAA that the dose treatment of *Metsulfuron methyl* herbicide has a significant effect on rice plant height.

Table 7. The Effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Average Rice Plant Height (cm)

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	6 WAA
A.	*Metsulfuron methyl*	15	24,70 a	30,06 b
B.	*Metsulfuron methyl*	20	23,34 a	29,96 b
C.	*Metsulfuron methyl*	25	24,64 a	30,14 b
D.	*Metsulfuron methyl*	30	23,92 a	24,74 a
E.	*Metsulfuron methyl*	35	24,14 a	29,78 b
F.	Manual control	-	32,43 b	33,58 c
G.	Control (Without treatment)	-	31,23 b	33,21 c

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

All dosage levels, as shown in Table above, generally showed significant differences in results when compared to manual weeding and control treatments up to 6 WAA of age. Based on these results, it can be concluded that the active ingredient *Metsulfuron methyl* affects the growth of rice plants. Herbicides can suppress the growth rate of weeds so that rice plants are able to compete with weeds in utilizing growth facilities such as nutrients, water, light and growing facilities to support the growth of rice saplings increasing (Deden and Umiyati, 2020).

Number of saplings per clump (tillers)

Based on observations, it can be seen that herbicide treatment does not have a noticeable effect on the number of saplings of rice plants (Table 8).

Table 8. The Effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on the Average Number of Rice Clump Saplings (saplings).

No.	Treatment	Dose (g/ha)	Observation	
			3 WAA	6 WAA
A.	*Metsulfuron methyl*	15	15,60 a	25,30 b
B.	*Metsulfuron methyl*	20	15,70 a	25,10 b
C.	*Metsulfuron methyl*	25	15,50 a	24,63 a
D.	*Metsulfuron methyl*	30	16,05 a	25,13 b
E.	*Metsulfuron methyl*	35	15,18 a	24,45 a
F.	Manual control	-	14,58 a	24,18 a
G.	Control (Without treatment)	-	15,75 a	24,48 a

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Table 8, shows that it does not cause interference with the growing process of the number of rice plant saplings. The uniformity in the number of saplings is thought not to be influenced by the active herbicide of the active ingredient *Metsulfuron methyl* whose function is more to control weeds, but the number of saplings is more influenced by the genetics of rice plants (Muhammad *et al*., 2022).

Dry Rice Milled Grain

Herbicide treatment of the active ingredient *Metsulfuron methyl* at a dose of 15 g / ha - 35 g / ha based on statistical analysis has a significant effect on the dry weight yield of rice mills (Table 9).

Table 9. The Effect of Dose Herbicide Active Ingredient *Metsulfuron methyl* on Average Yield of Dry Rice Milled Grain (Kg)

No.	Treatment	Dose (g/ha)	Yield per Plot (Kg)
A.	*Metsulfuron methyl*	15	13,87 b
B.	*Metsulfuron methyl*	20	14,15 c
C.	*Metsulfuron methyl*	25	13,34 bc
D.	*Metsulfuron methyl*	30	14,04 c
E.	*Metsulfuron methyl*	35	14,21 c
F.	Manual control	-	12,98 b
G.	Control (Without treatment)	-	10,20 a

Description: The average value followed by the same letter on the same factor and column shows an unreal difference on the Duncan Test 5%.

Herbicide treatment with active ingredients *Metsulfuron methyl* with a dose range between 15 g / ha to 35 g / ha has a significant effect on the yield of dry grain of rice plants when compared to manual weeding and control treatments. This result is because the control treatment has a high weed density that puts pressure on the growth of rice plants due to competition, ultimately disrupting causing low yields of dry milled grain. When viewed from the concentration level treatment given, it can be seen that the concentration of *Metsulfuron methyl* 35 g / ha is significantly different from the treatment at other concentration levels. The concentration of *Metsulfuron methyl* 35 g / ha is able to produce dry rice grain as much as 14.21 kg / plot or equivalent to 14,21 tons / hectare. These results are thought to be due to the application of the active ingredient herbicide *Metsulfuron methyl* which can suppress weed growth so that competition with rice plants becomes low and does not interfere with plant growth so that the availability of nutrients around it can increase the assimilation process (formation of carbohydrates) for maximum grain formation. According to Marpaung *et al*, (2013) that losses caused by weeds have a relationship between the time of emergence of weeds and the pressure exerted by plants. Yield losses are usually higher when weeds appear early in growth.

CONCLUSION

Herbicides made from *Metsulfuron methyl* have a significant effect on weed growth in rice plants when compared to controls. Herbicides with active ingredients *Metsulfuron methyl* with a dose range between 15 g / ha to 35 g / ha affect the total dry weight of weeds and weed poulation growth in rice plants such as *Cyperus iria*, *Fimbristylis miliacea* and *Leptochloa chinensis*. Herbicides with the active ingredient *Metsulfuron methyl* do not cause poisoning of the main rice crop. Herbicides made from *Metsulfuron methyl* do not have a toxic effect on rice plants of the Inpari 32 Cultivar. The dose of *Metsulfuron methyl* 35 g / ha is able to produce dry rice grain as much as 14.21 kg / plot or equivalent to 11,3 tons / hectare.

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