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The Effect of Butyl Cyhalophop Herbicide on Weeds, Growth and Yield of Rice Plants (*Oryza sativa* L.)

Dedi Widayat and Yayan Sumekar*
Faculty of Agriculture, Universitas Padjadjaran, Sumedang, Indonesia

For Correspondence

Yayan Sumekar
Faculty of Agriculture, Universitas Padjadjaran, Sumedang, Indonesia
yayan.sumekar@gmail.com

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Abstract: The presence of weeds in lowland rice plantations can result in a decrease in yields both in quality and quantity, so weeds in cultivation should absolutely be controlled. This study aims to determine the effectiveness of the butyl cyhalophop herbicide to control weeds in lowland rice cultivation. The experiment was conducted in the District of Rajagaluh, Majalengka Regency, West Java, from May to September 2019. The design of the test used was a randomized block design with 4 replications and 7 treatments. The treatment consisted of a dose of a butyl cyhalophop herbicide, a dose of 50; 75; 100; 125; 150 g/ha, manual weeding and control treatment (without weeding).The results showed that the butyl cyhalophop herbicide from 50 g / ha to 150 g / ha can control common weeds in lowland rice plants such as: *Echinochloa cruss-galli*, *Ludwigia octovalvis*, *Monochoria vaginalis*, *Cynodon dactylon*, *Cyperus iria*, and other weeds. Butyl cyhalophop herbicide from a dose of 50 g / ha to 150 g / ha does not cause poisoning in rice plants to 5 week after application. Treatment of Butyl cyhalophop herbicide from a dose of 50 g / ha to 150 g / ha can replace manual weeding and give no different rice yields.

I. Introduction

Rice (Oryza Sativa L) is the main food crop besides corn and wheat. Rice production in Indonesia tends to increase every year, where in 2011 Indonesian rice production amounted to 65,756,904 tons, in 2012 amounted to 69,056,126 tons, in 2013 amounted to 71,279,709 tons, in 2014 70,846,465 tons and in the year 2015 increased to 75,397,841 tons(Badan Pusat Statistik, 2015).Along with the increasing population, the amount of rice needs increases every year. According to Mulyani, *et. al.*, (2011) the need for rice in 2050 will increase to 48 million tons of rice, equivalent to 87 million tons of dry milled rice. Therefore, efforts are needed to increase rice production.

Weed is a type of plant that can reduce rice productivity. The presence of weeds in plants can lead to competition and competition for nutrients, water, light, CO2, and growing space (Soenardi, 2001). The level of competition between weeds and plants depends on environmental conditions, crop varieties, weed density, how long the plants grow with weeds, and the age of the plants when weeds begin to compete (Jatmiko *et al.*, 2002). According to Madkar (2002) the presence of weeds in rice plants can reduce yields by 30 to 47%.

Weed control can be done by sharing ways such as chemical control, chemical control is control by using chemicals (herbicides) that can suppress or even kill weeds (Moenandir, 1993). The reason farmers use herbicides is because of the lack of labor in weeding and the high cost of labor. This caused farmers who used to control weeds mechanically to switch to using chemical control by using herbicides (Pane *et al.*, 1999). Chemical control is felt to have a better advantage compared to other methods, both in terms of cost and labor (Sembodo, 2010).

One type of herbicide that can be used is 100 g / l butyl sihalofop. The butyl sihalofop herbicide is a phenoxy group.

The effectiveness of administration of herbicides is determined by the dose. The right dose of herbicide can kill the target weed, but if the dose is too high it will damage the cultivation plants (Sembodo, 2010).

II. Material and Method

The experiment was carried out in Rajagaluh Sub district, Majalengka Regency, West Java Province of Indonesia from May 2019 to September 2019. The rice variety used in this study was IR 64 variety. The test plot used was 3 mx 5 m with the distance between unit plots in the form Galengan with a width of 50 cm.

The materials used in this test include IR 64 cultivars and Amethys 100 SL (b.a: butyl cyhalophop 100 g / l). The tools used include a semi-automatic knapsack sprayer and T-jet nozets, measuring cups, hoes, kored, plastic bags, labels, ovens, scales, quadrants measuring 0.5 m X 0.5 m, and stationery and tools documentation.

The experiment consisted of 7 treatments with 4 replications as presented in Table 1. The experimental design used a Randomized Block Design. To test the mean values of different treatments used the Duncan test at a 95% confidence level. Prior to analysis of variance, the data observed from weed dry weights after application were transformed into $\sqrt{(y + 0.5)}$. The efficacy herbicide is the Amethys 100 SL herbicide (active ingredient of butyl cyhalophop100 g/l).

Table 1. Treatment efficacy testing

No.	Treatment	Dosage (g/ha)
A	Butyl cyhalophop	50
B	Butyl cyhalophop	75
C	Butyl cyhalophop	100
D	Butyl cyhalophop	125
E	Butyl cyhalophop	150
F	Manual weeding	-
G	Control (No Weeding)	-

Application of the butyl cyhalophop herbicide is done with semi automatic knapsack sprayer using blue T-jet nozzle pressurized 1 kg / cm^2 (15-20 psi.) and has a spray volume of 400 l / ha. Application of herbicides is carried out once, ie at 14 days after planting.

Response plan:

1. Weed Dry Weights

   The target weed dry weight was taken from 2 (two) sample plots covering 0.5 m x 0.5 m in each trial plot. Sampling of weeds dry weight is done by cutting fresh weeds to the level of the soil surface then weeds are collected according to the species. Furthermore, the weeds are dried in an oven at 800C for 48 hours or until they reach a constant dry weight then weighed. Observations were made at 4 and 6 Weeks after Application.

2. Rice Plant Phytotoxicity
   The level of poisoning was visually assessed against plant populations in the tiled plots, observed at 1, 2 and 3 weeks after the application of herbicides (MSA). Poisoning score between 0 - 4, which is as follows:
   0 = no poisoning, 0 - 5% of the shape and or color of leaves and / or abnormal growth of rice plants
   1 = mild poisoning,> 5-20% of the shape and or color of the leaves and or abnormal growth of rice plants
   2 = moderate poisoning,> 20 - 50% shape and or color of leaves and or abnormal growth of rice plants
   3 = poisoning weights,> 50 - 75% shape and or color of young leaves is not normal
   4 = poisoning very heavy,> 75% shape and or color of leaves and or abnormal growth of rice plants
3. Number of Rice Tillers
   The number of tillers is done by counting all the tillers that grow normally and the leaves are fully open. Observations were made on 12 plant samples taken at random, measured at 3 and 5 Weeks after Application.
4. Milled Dry Grain
   Observation of the results of dry unhusked rice (14% water content) was carried out on the tile plot measuring 2.5 m x 2.5 m.

III. Results and Discussion

1. Weed Dry Weights
   Dried weights *Echinochloa crus-galli*

Before the application of herbicide (experimental) weed Echinochloa crus-galli was the most dominant grass weed in the field at the experimental site. The results of observations of weights of Echinochloa crus-galli Echinochloa crus-galli are presented in Table 2. In observations 3 and 6 Weeks After Application shows that the dry weight of weeds Echinochloa crus = galli in the treatment of the herbicide Butyl sihalofop with a dose of 50 g / ha to 150 g / ha ha gives the smallest dry weight and is significantly different from manual weeding and control treatments.The control treatment showed the highest average dry weight of Echinochloa crus-galli weeds and was significantly different from other treatments. These results indicate that the herbicide Butyl cyhalophop from a dose of 50 g / ha is effective in controlling weed Echinochloa crus-galli until observation 6 Weeks After Application. This is in line with the opinion of Ntanos et al. (2000) that the type of herbicide with the active ingredient cyhalofop is able to control Echinochloa crus-galli at least 88% when applied at the beginning and end of post emergence.

Table 2. Effect of the application of the herbicide Butyl cyhalophop on the dry weights of *Echinochloa crus-galli* (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	3.03a	1.04a
B	Butyl cyhalophop dose 75 g/ha	2.76a	0.08a
C	Butyl cyhalophop dose 100 g/ha	1.77a	0.00a
D	Butyl cyhalophop dose 125 g/ha	3.01a	0.00a
E	Butyl cyhalophop dose 150 g/ha	2.76a	0.00a
F	Manual weeding	0.00a	5.12b
G	Control (No Weeding)	11.07b	15.87c

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

Dried weights *Ludwigia Octovalvis*

The results of observations of Ludwigia octovalvis weed dry weights are presented in Table 3. The results of statistical analysis of the average weights of Ludwigia octovalvis weeds are presented in Appendix 7 and 8. Table 3 shows that the treatment of the herbicide Butyl cyhalophop from doses of 50 g / ha to 150 g / ha gave the lowest average dry weed weights of Ludwigia octovalvis and were significantly different compared to manual weeding and control treatments at observations 4 and 6 weeks after application. The dry weights of Ludwigia perennis weed in the control treatment showed the highest and significantly different from other treatments at observations 3 and 6 weeks after application.

These results indicate that the use of the Butyl sihalofop herbicide from a dose of 50 g / ha has been effective in controlling weed Ludwigia octovalvis until the age of 6 weeks after application. the herbicide Butyl cyhalophop controls weeds by inhibiting the action of Acetyl Coenzyme-A Carboxylase. This enzyme acts in the biosynthesis of fatty acids. Inhibition of fatty acids causes fat loss and gradual death in the process of cell division at the point of growth (California Department of Pesticide Regulation, 2003).

Table 3. Effect of the application of the Butyl Sihalofop herbicide on the dry weight of the weed *Ludwigia octovalvis* (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	1.28a	1.81 a
B	Butyl cyhalophop dose 75 g/ha	0.00a	1.15 a
C	Butyl cyhalophop dose 100 g/ha	2.75a	0.16 a
D	Butyl cyhalophop dose 125 g/ha	0.00a	0.00 a
E	Butyl cyhalophop dose 150 g/ha	2.57a	0.00 a
F	Manual weeding	4.08ab	4.64 b
G	Control (No Weeding)	11.32b	10.46 c

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

Dried weights *Monochoria vaginalis*

The results of statistical analysis of the average dry weights of *Monochoria vaginalis* are presented in Table 4. In observations 3 weeks after application showed that the treatment of the herbicide Butyl cyhalophop from a dose of 50 g / ha to 150 g / ha gave an average dry weight of *Monochoria vaginalis*. the smallest and significantly different vaginalis to the control treatment, but not significantly different from the manual weeding treatment. The observation 6 to 6 weeks after application showed that the Butyl cyhalophop herbicide treatment from a dose of 50 g / ha to 150 g / ha gave the lowest average dry weed weights of *Monochoria vaginalis* and was significantly different from the manual weeding and control treatments (Table 4). The control treatment gave the highest dry weight of Monochoria vaginalis weed and was significantly different from other treatments.

This situation shows that the treatment of the herbicide Butyl cyhalophop starting at a dose of 50 g / ha is effective in controlling weed *Monochoria vaginalis* until 6 6 weeks after application. According to Damalas (2004) which states that with differences in chemical groups / groups, modes of action, and effects on metabolic pathways, herbicides can inhibit the work of enzymes or weed physiological processes.

Table 4. Effects of the application of the herbicide Butyl cyhalophop to the dry weights of *Monochoria vaginalis* (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	0.00a	1.85b
B	Butyl cyhalophop dose 75 g/ha	0.00a	0.00a
C	Butyl cyhalophop dose 100 g/ha	0.00a	0.00a
D	Butyl cyhalophop dose 125 g/ha	0.00a	0.00a
E	Butyl cyhalophop dose 150 g/ha	0.00a	0.00a
F	Manual weeding	0.00a	3.41c
G	Control (No Weeding)	0.81b	3.00d

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

Dry weights *Cyperus iria*

Before the weed experiment *Cyperus iria* was among the four dominant weeds at the trial site, but at the time of the weed experiment it was seen that there were quite a lot of growing locations in the experiment. Observations and data analysis showed that the application of the herbicide Butyl cyhalophop from a dose of 50 g / ha was able to reduce the dry weight of the Cyperus iria weed for up to 6 weeks after application and was significantly different from the control and treatment of weed control manually (Table 5). This can be interpreted that the application of the herbicide Butyl cyhalophop starting at a dose of 50 g / ha has been effective for controlling weed *Cyperus iria* .. Butyl cyhalophop herbicide belongs to the Arylopenoxypropionate (AOPP) group which inhibits the enzyme activity of Acetil Co-enzyme A carboxylase (Santaella *et al.* , 2006),

Table 5. Effect of application of the herbicide Butyl cyhalophop on the dry weight of weed *Cyperus iria* (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	0.00a	1.05a
B	Butyl cyhalophop dose 75 g/ha	0.00a	0.58a
C	Butyl cyhalophop dose 100 g/ha	0.00a	0.00a
D	Butyl cyhalophop dose 125 g/ha	0.00a	0.00a
E	Butyl cyhalophop dose 150 g/ha	0.00a	0.00a
F	Manual weeding	0.00a	5.84b
G	Control (No Weeding)	2.85b	7.59b

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

Dry Weight of *Cynodon Dactylon*

The results of statistical analysis of *Cynodon dactylon* average dry weight of *Cynodon dactylon* weeds are shown in Table 6. The results of observations of *Cynodon dactylon* weed dry weights showed that the treatment of the herbicide Butyl cyhalofop starting at a dose of 50 g / ha gave an average dry weight of weeds *Cynodon dactylon* and significantly different from the control, but not significantly different from manual treatment at observations 3 weeks after application. The observation 6 weeks after application can be seen showing that the treatment of the herbicide Butyl cyhalophop from a dose of 50 g / ha to 150 g / ha gives an average yield of dry weights of *Cynodon dactylon* that is lower and significantly different from manual and control treatments.

This shows that the treatment of the herbicide Butyl cyhalophop dose of 50 g / ha has been effective in controlling *Cynodon dactylon* weeds until the age of 6 weeks after application. This is because the herbicide Butyl cyhalophop is a selective herbicide against grass weeds.

Table 6. Effect of application of the Butyl cyhalophop herbicide on the dry weights of *Cynodon dactylon* (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	0.00a	0.39a
B	Butyl cyhalophop dose 75 g/ha	0.00a	0.00a
C	Butyl cyhalophop dose 100 g/ha	0.00a	0.00a
D	Butyl cyhalophop dose 125 g/ha	0.00a	0.00a
E	Butyl cyhalophop dose 150 g/ha	0.00a	0.00a
F	Manual weeding	0.00a	3.21b
G	Control (No Weeding)	2.85b	7.42c

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

Dried Weights Other Sepesies

Dried weights of other species are the dry weights of several weed species (not including the dominant species) found at the time of observation 3 weeks after application in the observed quadrats. Other species of weeds include *Leptochloa synensis, Limnocharis flava*, and *Marsilea crenata*.

Observation results showed that the average weed dry weight of other species in the treatment of herbicide Butyl cyhalophop from a dose of 50 g / ha to 150 g / ha was significantly different from the control treatment, but not different from the manual weeding treatment at the observation 3 weeks after application. On observation 6 weeks after application of the herbicide Butyl sihalofop dose from 50 g / ha to 150 g / ha gave the smallest and most significantly different average weed dry weights for manual weeding and control treatments (Table 7). This shows that the treatment of the herbicide Butyl cyhalophop dose of 50 g / ha has been effective in controlling weeds of other species until the age of 6 weeks after application.

Table 7. Effect of the application of the butyl sihalofop herbicide on the dry weights of other weeds (g / 0.25 m2)

No.	Treatment	Weed Dry Weights(g/0,25 m^2)	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	1.64a	6.84b
B	Butyl cyhalophop dose 75 g/ha	3.75a	0.88a
C	Butyl cyhalophop dose 100 g/ha	3.01a	0.68a
D	Butyl cyhalophop dose 125 g/ha	3.01a	0.51a

E	Butyl cyhalophop dose 150 g/ha	3.52a	0.32a
F	Manual weeding	18.75ab	22.22c
G	Control (No Weeding)	31.98b	44.24d

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

2. Phytotoxicity of Rice Plants

The results of observations on phytotoxicity in lowland rice plants 1, 3, and 5 weeks after application showed that the application of the herbicide Butyl cyhalophop from a dose of 50 g / ha to 150 g / ha did not cause symptoms of poisoning in lowland rice plants. (Table 8).

Table 8. Toxicity of lowland rice plants due to the treatment of the herbicide Butyl cyhalophop

No.	Treatment	Toxicity level		
		1 Weeks After Application	3 Weeks After Application	5 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	0	0	0
B	Butyl cyhalophop dose 75 g/ha	0	0	0
C	Butyl cyhalophop dose 100 g/ha	0	0	0
D	Butyl cyhalophop dose 125 g/ha	0	0	0
E	Butyl cyhalophop dose 150 g/ha	0	0	0
F	Manual weeding	0	0	0
G	Control (No Weeding)	0	0	0

5. Number of Rice Tillers

The number of rice tillers is one component of rice plant growth that can be observed to see the response of plant growth to treatments other than plant height. Rice tillers are indicators of growth of rice plants that show healthy or sick plants (Makarim and Suhartatik, 2008).

The results of observations of the number of paddy plants per clump showed that the treatment of the herbicide Butyl cyhalophop from a dose of 50 g / ha to 150 g / ha was not significantly different from the manual weeding and control treatments at 3 weeks after application, whereas at 6 weeks after application the rice yields in the control were smaller and significantly different from all other treatments (Table 9).

Table 9. Effect of the application of the herbicide Butyl cyhalophopto the number of Rice Tillers

No.	Treatment	Number of Rice Tillers	
		3 Weeks After Application	6 Weeks After Application
A	Butyl cyhalophop dose 50 g/ha	23.86a	33.94a
B	Butyl cyhalophop dose 75 g/ha	23.54a	33.23a
C	Butyl cyhalophop dose 100 g/ha	23.17a	32.92a
D	Butyl cyhalophop dose 125 g/ha	25.17a	35.25a
E	Butyl cyhalophop dose 150 g/ha	24.13a	34.25a
F	Manual weeding	22.73a	32.81a
G	Control (No Weeding)	21.71a	26.79 b

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

4. Milled Dry Grain

The results of the analysis of the yields of paddy rice due to treatment can be seen in Table 10. In Table 10 it can be seen that the control (without weeding) gives the smallest yield of 1175 g / 2 m2 or equivalent to 4.7 tons / ha of milled dry rice and significantly different from all the application of the herbicide Butyl sihalofop herbicide from a dose of 50 g / ha to 150 g / ha and manual weeding treatment. The small yield of rice in the control treatment is due to competition with weeds that are not controlled. According to Marpaung et. al, (2013) that the losses caused by weeds have a relationship between the time of the emergence of weeds and the pressure given by plants. Yield loss is usually higher when weeds appear early in growth.

Table 10. Effects of the application of the Butyl cyhalophopherbicide on Milled Dry Grain

No.	Treatment	Milled Dry Grain	
		g/2 m^2	Tons/ha
A	Butyl cyhalophop dose 50 g/ha	1.330 b	5,32
B	Butyl cyhalophop dose 75 g/ha	1.470 b	5,88
C	Butyl cyhalophop dose 100 g/ha	1.400 b	5,76
D	Butyl cyhalophop dose 125 g/ha	1.490 b	5,96
E	Butyl cyhalophop dose 150 g/ha	1.465 b	5,86
F	Manual weeding	1.470 b	5,88
G	Control (No Weeding)	1.175 a	4,70

Note: numbers followed by the same letter in the same column show no significant difference in Duncan's test at 5% significance level

IV. Conclusion

1. Butyl cyhalophop herbicide from 50 g / ha to 150 g / ha can control common weeds in lowland rice plants such as: *Echinochloa cruss-galli, Ludwigia octovalvis, Monochoria vaginalis, Cynodon dactylon, Cyperus iria,* and other weeds.
2. Butyl cyhalophop herbicide from a dose of 50 g / ha to 150 g / ha does not cause poisoning in rice plants to 5 week after application.
3. Treatment of Butyl cyhalophop herbicide from a dose of 50 g / ha to 150 g / ha can replace manual weeding and give no different rice yields.

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