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Effectiveness of Butyl Cyhalofop 55 g/l and Penoxsulam 15 g/l Herbicide on weed growth and rice yield in direct seeded system

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Abstract
Uncontrolled weeds can reduce the growth and yield of paddy fields. Weed control that is widely used is by using herbicides. This experiment aims to determine the effect of the herbicide dose of Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/l on the growth of weeds and components of rice products. The trial was conducted from November 2024 - March 2025 at the SPLPP Ciparay Rice Field, Baleendah District, Bandung Regency, West Java. This study used the Randomized Complete Block Design method with 7 treatments and 4 replicates. Treatment consisted of a mixed herbicide dose of Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/l with a dose of 1.5; 2.0; 2.5; 3.0; 3.5 l/ha, manual weeding, and control (without weed control). The results showed that a mixed herbicide of Butyl Cyhalofop 55 g/l + Penoxulome 15 g/l with a dose of 1.5 l/ha – 3.5 l/ha can suppress the dry weight of broadleaf weeds (*Ludwigia octovalvis*), grass weeds (*Echinochloa crus-galli, Leptochloa chinensis*), and sedge weeds (*Fimbristylis miliacea, Cyperus iria*), and does not cause phytotoxicity to paddy rice plants. Mixed herbicide of Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/l with a dose of 1.5 l/ha – 3.5 l/ha has a good effect on plant height, number of vegetative saplings and rice crop yield.

Keywords: Weeds, Butyl Cyhalofop 55 g/L, Penoxsulam 15 g/L, Rice

Introduction

Rice is one of the staples with a high consumption rate in the world, especially Asia. During 2018-2020, rice consumption in Asia was the highest compared to other countries in the world, at 77.2 kg per person per year (OECD, 2020) [12]. Along with the population growth rate, the need for staple foodstuffs such as rice will increase, including in Indonesia. Based on population administration data, the population growth rate in Indonesia in 2023 is 1.13% with a total population of 279 million people (BPS, 2024) [2]. On the other hand, in 2023 milled dry grain production decreased by 1.40% from 2022, which was 54.75 million tons to 53.98 million tons (BPS, 2023) [3]. Increasing rice production is needed to meet the needs in Indonesia. Rice cultivation has several obstacles such as limited land, soil fertility, and plant pest organisms such as weeds (Zarwazi *et al.*, 2016) [25].

Weeds are plants that can compete with the main plants in obtaining sunlight, water, and nutrients so that the main plants have the potential to lose yield (Yuliana & Ami, 2020) [23]. There are several types of weeds that are commonly found in rice cultivation including *Cyperus iria*, *Cyperus disfformis*, *Fimbristylis miliacia*, *Fimbristylis dichomata*, *Cuphea carthagenesis*, *Monochoria vaginalis*, *Echinochloa colona* L. *and Echinochloa crusgalli* (Yani *et al.*, 2022) [22]. Weeds that are not controlled in rice cultivation can affect rice yields (Syarifah *et al.*, 2018) [18]. Weed disturbances can result in a decrease in rice production by 15-42% and gogo rice by 47-87% (Widiyawati *et al.*, 2017) [20]. Effective and efficient weed control needs to be done to prevent rice yield loss.

Weed control can be done through several methods such as prevention, physical, biological, and chemical control with herbicides (Widaryanto & Zaini, 2021) [19]. Chemical weed control using herbicides is more widely used because it is more effective and efficient in controlling weeds compared to other control methods (Yadav *et al.*, 2018) [21]. Herbicide applications need to be considered so as not to cause environmental pollution or negatively impact non-target organisms. Another influence, weed resistance can occur due to the continuous use of herbicides with the same active ingredient for a long time (Knezevic *et al.*, 2017) [8].

Herbicides can be classified into selective and non-selective herbicides based on the response of the weed type to the herbicide (Hengki *et al.*, 2018) [6]. Herbicides with active ingredients Butyl Cyhalofop have selective and systemic properties that can be applied post-growth and are effective in controlling grass weeds (Sen *et al.*, 2021) [15]. The active ingredient herbicide Penoxsulam is a selective and systemic pre-growth herbicide that can control weeds of the broadleaf, teak, and grass groups (Dow Chemical Company, 2008) [7]. The use of mixed herbicides with different active ingredients is intended to obtain a wider range of control and dose suppression than separate herbicide applications, as well as prevent weed resistance to herbicide applications with a single active ingredient (Zimdhal, 2007) [26]. This experiment was conducted to determine the effect of the herbicide dose of a mixture of Butyl Cyhalofop 55 g/l and Penoxsulam 15 g/l on the growth of weeds and components of rice products.

Material and Methods

The research was conducted from November 2024 to March 2025, in SPLPP Ciparay rice fields, Baleendah District, Bandung Regency, West Java. The materials used in this study include Ciherang cultivar rice seeds, Urea fertilizer, SP-36, and KCl, Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L herbicide and water as a solvent. The equipment used includes semi-automatic back spray and T-jet nozzles, measuring cups, pipettes, buckets, analytical scales, ovens, quadrant irons, meters, paper envelopes, as well as

stationery and documentation. The research method used used a group random design with 7 treatments of herbicide dose of Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L (A: 1.5 l/ha; B: 2.0 l/ha; C: 1.5 l/ha; D: 3.0 l/ha; E: 3.5 l/ha; F: Manual weeding; and G: Without weed control) and the experiment was repeated 4 times.

Observation of the analysis of initial weed vegetation was carried out as a supporting observation. The primary observations were made at 3 and 6 Weeks after Application (WAA) which included weed observation and plant observation. Weed samples were taken from two 0.5 m x 0.5 m quadrant plots by cutting weeds above ground level, then separated according to species, then dried in an oven at 80°C for 48 hours or reaching a constant dry weight and then weighed. Observations of rice plants include plant height, number of seedlings, and Dried Milled Grain. Phytotoxicity observations were performed at 1, 2, and 3 Weeks after Application (WAA). Data processing was carried out by ANOVA and Duncan test at a real level of 95%.

Results and Discussion

Ludwigia octovalvis Dry Weight

The results of observation and ANOVA on the effect of mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha on the dry weight *of Ludwigia octovalvis* weed can be seen in Table 1. In observations 3 and 6 WAA, mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha showed lower results and significantly different from the dry weight of *Ludwigia octovalvis* weeds compared to manual control and weeding treatments. Mixed herbicides of Butyl Cyhalofop and Penoxsulam are effective in reducing the dry weight of weeds up to 60 DAA, including *Ludwigia* sp. weeds on the research site (Raj *et al.*, 2021) [13].

Table 1: Effect of Herbicide Application on Dry Weight of *Ludwigia octovalvis*

Treatment	Dosage l/ha	Weed Dry Weight (g)	
		3 WAA	6 WAA
A Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	1.5	0.89 ab	3.29 a
B Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L	2.0	0.48 ab	3.05 a
C Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	2.5	0.33 ab	2.66 a
D Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.0	0.08 a	2.16 a
E Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.5	0.00 a	1.89 a
F Manual Weeding	-	1.11 b	7.32 b
G Control	-	3.00 c	13.19 c

Notes: The average value marked with the same letter in the same column shows no real difference at the level of 5% according to the Duncan Test. WAA = Week After Application

Echinochloa crus-galli Dry Weight

The results of observation and ANOVA of the effect of mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha on the dry weight of *Echinochloa crus-galli* weed can be seen in Table 2. In observations 3 and 6 WAA, mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha showed lower results and a marked difference in the dry weight of *Echinochloa crus-galli* weed compared to the control treatment but no significant difference compared to manual weeding. Mixed herbicides of Butyl Cyhalofop and Penoxsulam are not antagonistic in controlling the *weed Echinochloa crus-galli* (Guntoro & Fitri, 2013) [4]. Research (Lap *et al.*, 2013) also showed that a mixture of the active ingredients Butyl Cyhalofop and Penoxsulam was able to control *Echinochloa* spp. very well [9].

Table 2: Effect of Herbicide Application on Dry Weight of *Echinochloa crus-galli*

Treatment	Dosage l/ha	Weed Dry Weight (g)	
		3 WAA	6 WAA
A Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	1.5	0.63 a	1.68 b
B Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L	2.0	0.49 a	0.98 ab
C Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	2.5	0.43 a	0.56 ab
D Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.0	0.26 a	0.49 ab
E Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.5	0.11 a	0.24 a
F Manual Weeding	-	0.58 a	1.91 b
G Control	-	1.83 b	3.81 c

Notes: The average value marked with the same letter in the same column shows no real difference at the level of 5% according to the Duncan Test. WAA = Week After Application

Leptochloa chinensis Dry Weight

The results of observation and analysis of various traces of the effect of mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha on the dry weight of *Leptochloa chinensis* weeds can be seen in Table 3. In observations 3 and 6 WAA, mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha showed lower results and significantly different from the dry weight of *Leptochloa chinensis* weeds compared to the control treatment but no significant difference from manual weeding. Weed control with mixed active ingredients is more effective compared to manual weeding as it can reduce costs and shorter time (Lolitasari & Hasjim, 2019) [11].

Table 3: Effect of Herbicide Application on Dry Weight of *Leptochloa chinensis*

Treatment	Dosage l/ha	Weed Dry Weight (g)	
		3 WAA	6 WAA
A Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	1.5	0.63 a	1.93 b
B Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L	2.0	0.49 a	0.98 ab
C Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	2.5	0.43 a	0.56 ab
D Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.0	0.26 a	0.49 ab
E Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.5	0.11 a	0.24 a
F Manual Weeding	-	0.58 a	1.91 b
G Control	-	1.83 b	3.81 c

Notes: The average value marked with the same letter in the same column shows no real difference at the level of 5% according to the Duncan Test. WAA = Week After Application

Fimbristylis miliacea Dry Weight

The results of observation and analysis of various traces of the effect of mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha on the dry weight of *Fimbristylis miliacea* weeds can be seen in Table 4. In observations 3 and 6 WAA, mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha showed lower and significantly different results on the dry weight of *Fimbristylis miliacea* weeds compared to manual control and weeding treatments. Mixed herbicides of Butyl Cyhalofop and Penoxsulam are herbicides with a broad control spectrum including grass weeds and sedge by damaging the weed metabolic system (Sudhana *et al.*, 2018) [16].

Table 4: Effect of Herbicide Application on Dry Weight of *Fimbristylis miliacea*

Treatment	Dosage l/ha	Weed Dry Weight (g)	
		3 WAA	6 WAA
A Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	1.5	1.31 bc	3.89 b
B Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L	2.0	0.85 abc	3.46 ab
C Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	2.5	0.64 ab	2.95 ab
D Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.0	0.49 ab	2.43 a
E Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.5	0.28 a	2.24 a
F Manual Weeding	-	1.53 c	6.29 c
G Control	-	2.73 d	10.32 d

Notes: The average value marked with the same letter in the same column shows no real difference at the level of 5% according to the Duncan Test. WAA = Week After Application

Dried Milled Grain (DMG)

The results of observation and analysis of various traces of the effect of mixed herbicides of Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha on the weight of milled dry grain of rice can be seen in Table 5. In Table 5, all herbicide dose treatments mixed with Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L resulted in a significantly different weight of milled dry grain and higher than control but not significantly different compared to manual weeding. Mixed herbicide treatment of Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha showed results equivalent to manual weeding to increase rice crop yields. An increase in the weight of DMG of rice can reach 5-7 tons/ha with weed control (Respati *et al.*, 2015) [14]. Nutrient absorption of rice will be higher if the weed density is low, so the rate of photosynthesis will increase and increase the amount and weight of grain (Sumoharjo *et al.*, 2023) [17].

Table 5: Observations on Dried Milled Grain (DMG) of Rice

Treatment	Dosage l/ha	Dried Milled Grain (DMG) (g/6,25m^2)
A Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	1.5	366.00 b
B Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L	2.0	367.25 b
C Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	2.5	368.00 b
D Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.0	369.75 b
E Butyl Cyhalofop 55 g/L + Penoxsulam 15 g/L	3.5	370.25 b
F Manual Weeding	-	364.25 b
G Control	-	311.00 a

Notes: The average value marked with the same letter in the same column shows no real difference at the level of 5% according to the Duncan Test. WAA = Week After Application

Conclusion

Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/l herbicide at a dose of 1.5 l/ha – 3.5 l/ha can suppress the dry weight of broadleaf weeds (*Ludwigia octovalvis*), grass weeds (*Echinochloa crus-galli, Leptochloa chinensis*), and sedge weeds (*Fimbristylis miliacea, Cyperus iria*), and do not cause phytotoxicity to paddy rice plants. Herbicides with active ingredients mixed with Butyl Cyhalofop 55 g/l + Penoxsulam 15 g/L at a dose of 1.5 l/ha – 3.5 l/ha have a good effect on plant height, number of tillers, and rice crop yield.

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