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Evaluating the Impact of Single and Mixed Herbicides on Corn (*Zea Mays* L.) Growth and Yield in Dry Land

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Abstract

The Indonesian Government's efforts to enhance Human Resource (HR) quality include ensuring adequate food production, purchasing power, access, and nutritional intake. This study aims to assess the impact of single and mixed herbicides on corn plant growth and yield. Employing a Randomized Block Design (RBD) with eight treatments replicated three times, the research was conducted from February to June 2023 at the Farmer's Gar-den. Results indicated that herbicide treatments, particularly those with atrazine + saflufenacil as the active in-gredients, demonstrated the most favorable effects on plant height at 6 WAP and 8 WAP, the number of leaves at 6 WAP, ear length, ear weight, and dry seed weight per plot. The atrazine + saflufenacil herbicide treatment had the best effect on plant height at 6 WAP and 8 WAP, number of leaves at 6 WAP, ear length, ear weight, and dry seed weight per plot.

Keywords : herbicides, atrazine, saflufenacil, nicosulfuron, corn.

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1. Introduction

The Indonesian Government aims to enhance Human Resources (HR) quality by ensuring sufficient food production, purchasing power, access, and nutritional intake—a fundamental right for global resilience. The agricultural sector's sustainability confronts challenges, notably farmer regeneration [1], involving the transition of farming activities from older to younger generations [2]. As a predominantly agricultural nation, Indonesia relies on farmers for income and food production, emphasizing their crucial role in national development [3], [4].

In Indonesia, the word food is synonymous with rice because rice is the leading staple food for society. But there are other types of food commodities, including corn (*Zea mays* L) [5]. Corn is a cereal crop [6], corn is also a strategic commodity in the development of agriculture and the Indonesian economy [7], considering that this commodity has a multipurpose function both for food and as feed for livestock [8]. The need for corn commodities will continue

to increase for food consumption, dinner, and industrial raw materials [9]. Corn consumption in Indonesia is currently relatively high, with around 10 million tons of dry-shelled Corn per year [5]. Weeds are other plants that grow on cultivated land and grow in unwanted places so that their presence will be detrimental [8]. There are several types of weed groups, namely the grass weed group, the broad leaf weed group, and the fern weed group such as *Neprolepis bisserata*, *Stenoclaena palustris*, and *Dicranopteris linearis* [10].

Yield losses due to weeds in corn plants range between 20% - 80% [11], depending on the type and density of weeds and the time of weed disturbance [12]. Therefore, the presence of weeds must be controlled so that they do not disturb cultivated plants so that the plants obtain optimal growth. According to [13], Nutrient competition due to the presence of weeds in corn planting areas can cause significant yield losses in corn plants. Manual weed control requires a lot of labor, so manual weeding is increasingly expensive [14]. Therefore, one alternative is to use herbicides. The active ingredients contained are one factor that will determine the success of weed control [15]. Mixing several herbicides with

different active ingredients can broaden the control spectrum, slow down weed resistance, and reduce production costs [16]. Based on the results of research [7], it is stated that the mixed herbicide atrazine 500 g/l + mesotrion 50 g/l with a dose of 1.5 l/ha - 3.0 l/ha is able to suppress the growth of weeds *Ageratum conyzoides*, *Richardia brasiliensis*, *Synedrella nodiflora*, and does not cause poisoning to corn plants. The results of research [17], showed that the combination of metsulfuron-methyl with 2,4-D, ametrin, or diuron showed better efficacy than a single application of metsulfuron-methyl. The combination of the herbicides atrazine and nicosulfuron can be economically profitable because the herbicide dose used is lower, and ecologically, it can inhibit resistance in weeds [18]. This study aims to assess the impact of single and mixed herbicides on corn plant growth and yield.

2. Materials and Methods

2.1 Time and Materials

This research in February 2023 – June 2023 at the Farmer's Garden. This research used hoes, machetes, ropes, knapsack sprayers, electric scales, cameras, stationery, treatment labels, measuring tape, waring and wood sticks, Pioneer 21 corn seeds, NPK fertilizer, herbicides containing the active ingredient atrazine, herbicides containing the active ingredient suflufenacil, herbicides containing active nicosulfuron, herbicide containing the active ingredients atrazine and saflufenacil, herbicide containing the active ingredients atrazine and nicosulfuron, herbicide containing the active ingredients atrazine + saflufenacil + nicosulfuron and water.

2.2 Research methods

The experimental method used was RBD (Randomized Block Design) which consisted of 8 treatments, namely H₀ control (without weed control), H₁ mechanical weeding, H₂ herbicide atrazine, H₃ herbicide suflufenacil, H₄ herbicide nicosulfuron, H₅ herbicide atrazine + saflufenacil, H₆ herbicide atrazine + nicosulfuron, H₇ herbicide atrazine + saflufenacil + nicosulfuron. Each treatment was repeated three times to obtain 24 experimental plots.

The data obtained will be analyzed using the diversity analysis method (Anova) using R studio software. The treatment has a natural effect if the $F > F_{Table}$ is at the 5% test level. Next, to see the differences, further tests were carried out using the Honestly Significant Difference (HSD) test at the 5% level to compare the averages between treatments.

2.3 Observed Variables

Observations were made on corn plants, which included several components (variables), namely plant height at 6 and 8 WAP, number of leaves at 6 and 8 WAP, cob length, cob weight, weight of 100 seeds, and seed weight

per plot.

3. Results and Discussion

The research results show that the height of corn plants at 6 WAP shows that treatment H₅ is not significantly different from treatments H₂, H₆, and H₇ but is substantially different from treatments H₀, H₁, H₃, and H₄ on the plant height variable at 6 WAP, on the height variable 8 WAP plants in the H₅ treatment were not significantly different from the H₀, H₁, H₂, H₃, H₆, and H₇ treatments, but were very different from the H₄ treatment.

Table 1. Effect of herbicide treatment on plant height.

Treatment	Plant height 6 WAP		Plant height 8 WAP		
H ₀	157,33	a	237,25	ab	
H ₁	166,58	ab	244,33	ab	
H ₂	175,08	abc	251,50	b	
H ₃	165,33	ab	247,92	ab	
H ₄	169,25	ab	227,92	a	
H ₅	191,58	c	253,50	b	
H ₆	183,17	bc	249,50	247,17	ab
H ₇	177,25	abc		ab	
HSD 0,05	20,91		23,53		

Note: Numbers followed by the same letter in the same column are not significantly different.

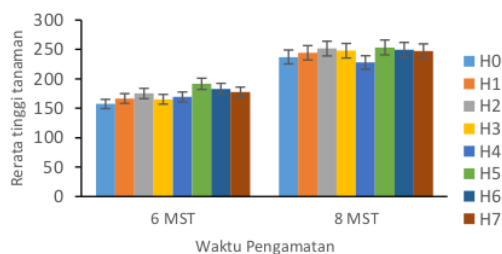


Figure 1. Average plant height

A good photosynthesis process can influence the height growth of corn plants [19]. Based on the analysis of variance in Table 1, each atrazine + Saflufenacil herbicide treatment had an average plant height that was higher and significantly different compared to the Control treatment at observations 6 and 8 WAP. This shows that applying the herbicide atrazine + Saflufenacil effectively controls weeds and has a good influence on the height growth of corn plants. In line with research results [20], [21] weeds that compete with corn can inhibit corn growth. Research [22] showed that the herbicide treatment atrazine + Nicosulfuron at a dose of 1.5

– 3.0 l/ha showed the highest average plant height compared to the control.

The effect of treatment on the number of leaves shows that treatment H₅ is not significantly different from treatments H₂, H₄, H₆, and H₇ but is substantially different from treatments H₀, H₁, and H₃ for the number of leaves variable at 6 WAP, in while for the variable number of leaves at 8 WAP all treatments are not different authentic.

Table 2. Effect of herbicide treatment on leaf number.

Treatment	Number of leaf 6 WAP		Number of leaf 8 WAP	
H ₀	8,33	a	16,17	a
H ₁	8,92	a	16,33	a
H ₂	9,75	ab	16,33	a
H ₃	8,33	a	16,00	a
H ₄	9,25	ab	16,58	a
H ₅	10,67	b	16,42	a
H ₆	9,50	ab	15,58	a
H ₇	9,33	ab	16,17	a

HSD 0,05 1,74 tn
 Note: Numbers followed by the same letter in the same column are not significantly different.

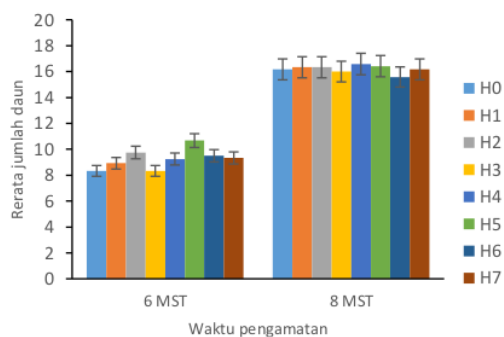


Figure 2. Average number of leaf

The herbicide atrazine + saflufenacil can suppress weed growth without competition for nutrients, water, or growing space. In GM corn plants, glyphosate, which inhibits the activity of the plant's EPSPS enzyme, which stops the biosynthesis process of aromatic amino acids, does not work so that plants are tolerant to glyphosate herbicide compounds and the metabolism needed for growth can continue [23].

The results of the HSD test on the effect of herbicides on corn cob length and corn cob weight showed that treatment H₅ was significantly different from treatment H₀ and not substantially different from treatments H₁, H₂, H₃, H₄, H₆, and H₇.

Table 3. Effect of herbicide treatment on cob length and cob weight.

Treatment	Cob length		Cob weight	
H ₀	16,67	a	240,41	a
H ₁	18,89	ab	295,28	ab
H ₂	19,49	ab	311,96	ab
H ₃	18,44	ab	291,70	ab
H ₄	20,72	ab	279,18	ab
H ₅	23,33	b	342,54	b
H ₆	21,02	ab	311,92	ab
H ₇	20,82	ab	320,25	ab
HSD 0,05	5,27		82,52	

Note: Numbers followed by the same letter in the same column are not significantly different.

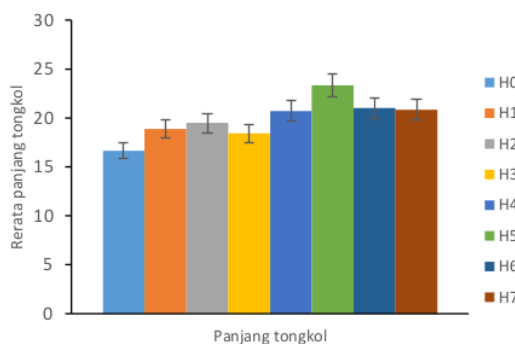


Figure 3. Average cob length

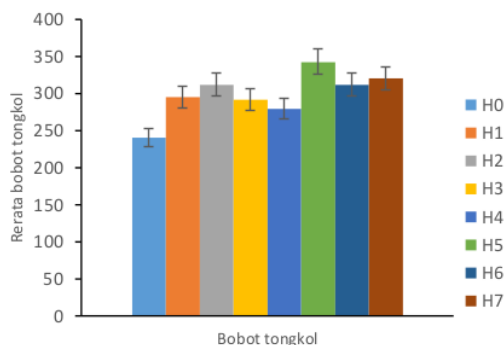


Figure 4. Average cob height

The length of corn cobs is strongly influenced by environmental factors. The control treatment of corn plants produces the shortest cobs, aligning with [24], emphasizing the significant impact of environmental factors on plant photosynthesis. As per [25], intense weed competition with cultivated plants can decrease crop yields due to lower photosynthate and energy (ATP) formation, leading to reduced photosynthate translocation. Consistent with

research by [7], effective weed control results in heavier corn cobs compared to situations where corn cobs are overshadowed by weeds.

The results of the HSD test on the effect of herbicides on the dry seed weight of corn plants showed that all treatments were not significantly different. In contrast, the dry seed weight per plot showed that treatment H5 significantly differed from treatment H₀ and not substantially different from treatments H₁, H₂, H₃, H₄, H₆, and H₇.

Table 4. Effect of herbicide treatment on weight of 100 seeds and seed weight per plot.

Treatment	Weight of 100 seeds		Dry seeds weight per plot	
H ₀	34,42	a	3,56	a
H ₁	35,99	a	4,20	ab
H ₂	38,28	a	4,52	ab
H ₃	35,72	a	4,08	a
H ₄	35,99	a	4,56	ab
H ₅	36,72	a	5,47	b
H ₆	35,02	a	4,33	ab
H ₇	38,52	a	4,36	ab
HSD 0,05	8,02		1,31	

Note: Numbers followed by the same letter in the same column are not significantly different.

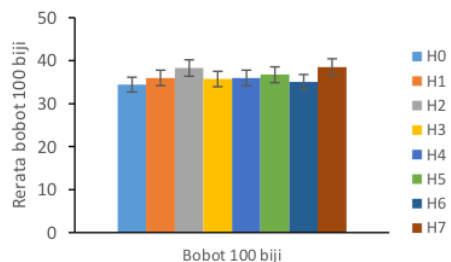


Figure 5. Average weight of 100 seeds

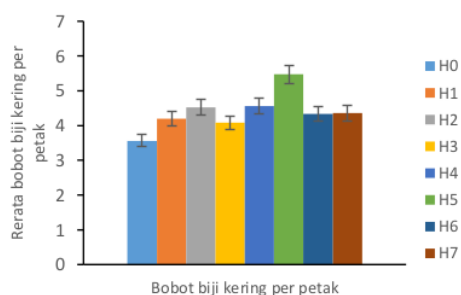


Figure 6. Average dry seeds weight per plot

The higher the translocation of photosynthate into corn kernels, the greater the dry weight of corn kernels [26]. In Table 4, the atrazine + saflufenacil +nicosulfuron herbicide treatment produced the highest weight of 100 seeds, averaging 38.52 g. Conversely, the atrazine + saflufenacil herbicide treatment yielded the highest dry seed weight per plot, averaging 5.47 kg. The control treatment resulted in the lowest dry seed weight due to weed competition, hindering proper nutrient absorption by corn plants [27].

4. Conclusion

The atrazine + saflufenacil herbicide treatment had the best effect on plant height at 6 WAP and 8 WAP, number of leaves at 6 WAP, ear length, ear weight, and dry seed weight per plot.

5. Acknowledgement

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