**BIOVALENTIA: BIOLOGICAL RESEARCH JOURNAL**
***e*-ISSN: 2477-1392**
**Vol. 9 No. 2, Nov 2023**

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

Nopit Yohanes[1], Yakup Yakup[2*], M. Umar Harun[2]

*[1]Master Program in Agriculture Science, Faculty of Agriculture, Sriwijaya University, Jalan Padang Selasa 524, Palembang, South Sumatra 30139, Indonesia*
*[2]Departement of Agronomy, Faculty of Agriculture, Sriwijaya Univesity, Jalan Palembang-Prabumulih km 32, Indralaya Indonesia*

*Corresponding author

*E-mail address: yakup.parto@yahoo.com (Nopit Yohanes).*
*Peer review under responsibility of Biology Department Sriwijaya University*

## 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.*

*Received: September 24, 2023, Accepted: November 30, 2023*

## 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 $H_0$ control (without weed control), $H_1$ mechanical weeding, $H_2$ herbicide atrazine, $H_3$ herbicide suflufenacil, $H_4$ herbicide nicosulfuron, $H_5$ herbicide atrazine + saflufenacil, $H_6$ herbicide atrazine + nicosulfuron, $H_7$ 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 $H_5$ is not significantly different from treatments $H_2$, $H_6$, and $H_7$ but is substantially different from treatments $H_0$, $H_1$, $H_3$, 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 $H_0$, $H_1$, $H_2$, $H_3$, $H_6$, and $H_7$ treatments, but were very different from the $H_4$ 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.

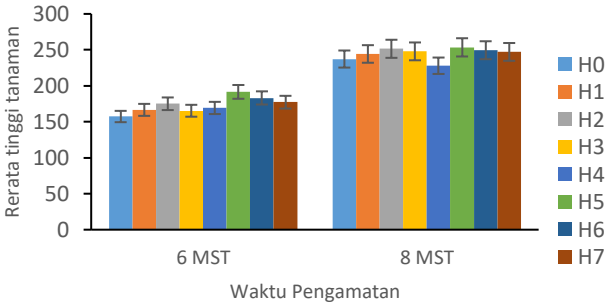


Figure 1. Average plant height

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 $H_5$ is not significantly different from treatments $H_2$, $H_4$, $H_6$, and $H_7$ but is substantially different from treatments $H_0$, $H_1$, and $H_3$ 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.

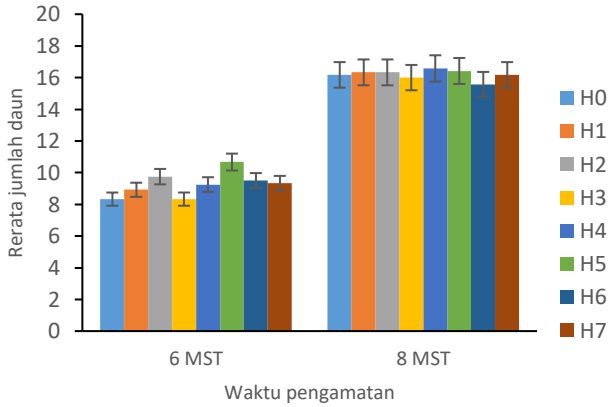


Figure 2. Average number of leaf

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 $H_5$ was significantly different from treatment $H_0$ and not substantially different from treatments $H_1$, $H_2$, $H_3$, $H_4$, $H_6$, and $H_7$.

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

| Treatment | Cob lenght | | 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.

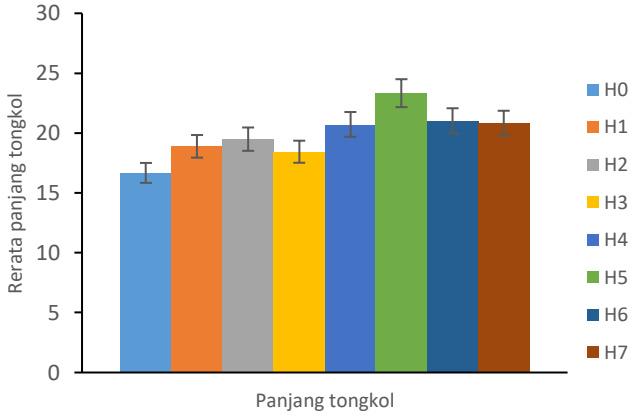


Figure 3. Average cob length

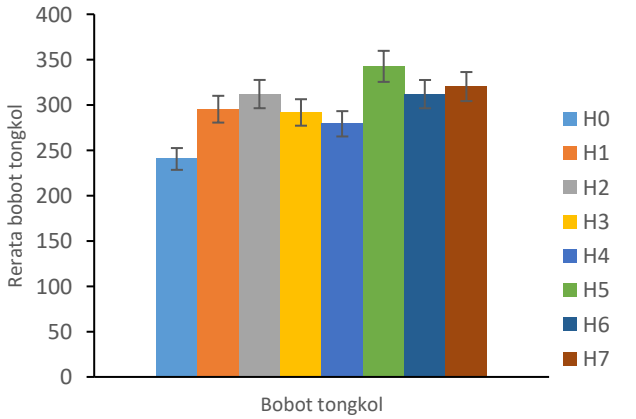


Figure 4. Average cob height

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 $H_0$ and not substantially different from treatments $H_1$, $H_2$, $H_3$, $H_4$, $H_6$, and $H_7$.

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.

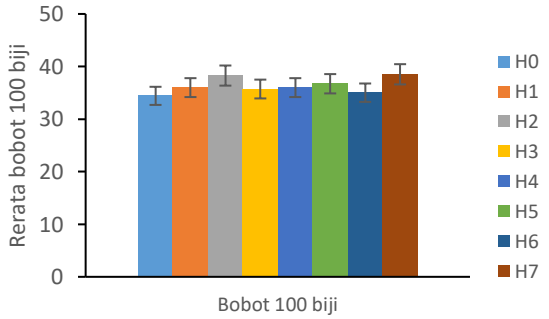


Figure 5. Average weight of 100 seeds

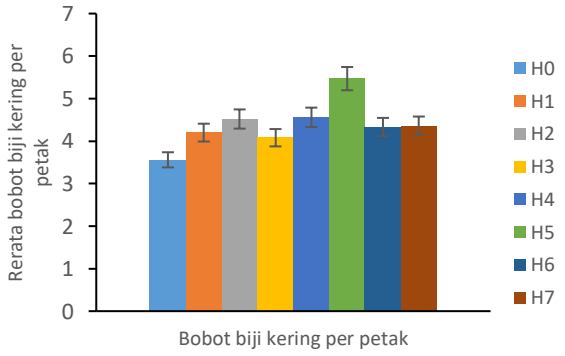


Figure 6. Average dry sedds weight per plot

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

We appreciate all parties who have helped us in conducting research and prepar-ing this manuscript.

## References

[1] N. F. W. Astuti, "The Socio Demographic of Farmers ' Household Food Security in Indonesia : A Literature Review," *J. Kesehat. Masy. MULAWARMAN*, vol. 4, no. 2, pp. 38–52, 2022.

[2] M. Erliaristi, K. Prayoga, and J. Mariyono, "Persepsi Pemuda Terhadap Profesi Petani Padi Di Kota Semarang," *J. Pemikir. Masy. Ilm. Berwawasan Agribisnis*, vol. 8, no. 2, pp. 1387–1408, 2022.

[3] I. K. Suratha, "Krisis Petani Berdampak Pada Ketahanan Pangan Di Indonesia," *Media Komun. Geogr.*, vol. 16, no. 1997, pp. 67–80, 2015.

[4] A. D. Wangi and D. Adriansyah, "Analisis Faktor-Faktor yang Mempengaruhi Produktivitas Jagung Pipil Di Desa Kelubir Kecamatan Tanjung Palas Utara," *J. Ilmu Pertan. Kaltara*, vol. 1, no. 1, pp. 6–13, 2023.

[5] N. I. Lestari, W. Erawan, F. Awaliyah, and T. Febrianti, "Analisis Usahatani Jagung Pipilan Berdasarkan Status Penguasaan Lahan di Desa Babakanloa Kecamatan Pangatikan Kabupaten Garut," *Paradig. Agribisnis*, vol. 4, no. 2, pp. 103–112, 2022.

[6] J. . Fabians, Hitijahubessy, and A. Siregar,

"Peranan Bahan Organik dan Pupuk Majemuk NPK dalam Menentukan Percepatan Pertumbuhan Tanaman Jagung (*Zea mays* Saccharata L.) pada Tanah Inceptisol," *J. Budid. Pertan.*, vol. 12, no. 1, pp. 1–9, 2016.

[7] U. Umiyati, D. Widayat, D. Kurniadie, R. Y. Fadillah, and D. Deden, "Pengaruh Campuran Herbisida Atrazin 500 g/l dan Mesotrion 50 g/l Terhadap Pertumbuhan Beberapa Jenis Gulma Serta Hasil Jagung (*Zea mays* L.)," *J. Agrosintesa*, vol. 2, no. 1, pp. 9–18, 2019.

[8] W. J. Padang, E. Purba, and E. S. Bayu, "Periode Kritis Pengendalian Gulma Pada Tanaman jagung (*Zea mays* L.)," *J. Agroekoteknologi FP USU*, vol. 5, no. 2, pp. 409–414, 2017.

[9] I. Tustiyani, D. R. Nurjanah, S. S. Maesyaroh, and J. Mutakin, "Identifikasi Keanekaragaman dan Dominansi Gulma pada Lahan Pertanaman Jeruk (*Citrus sp*.)," *Kultivasi*, vol. 18, no. 1, pp. 779–783, 2019.

[10] M. Iqbal, L. Mawarni, and E. Purba, "Pengendalian Gulma Dengan Saflufenacil Secara Tunggal dan Campuran pada Pertanaman Kelapa Sawit (*Elaeis guineensis* Jacq.) Belum Menghasilkan di Lahan Gambut," *J. Agroteknologi FP USU*, vol. 6, no. 3, pp. 592–598, 2018.

[11] W. Bilman, "Analisis Pertumbuhan Tanaman Jagung Manis (*Zea mays* Saccharata) Pergeseran Komposisi Gulma pada Beberapa Jarak Tanam," *J. Ilmu-Ilmu Pertan. Indones.*, vol. 3, no. 1, pp. 25–30, 2011.

[12] D. Kurniadie, U. Umiyati, and S. Shabirah, "Pengaruh Campuran Herbisida Berbahan Aktif Atrazin 500 g/L dan Mesotrion 50 g/L Terhadap Gulma Dominan pada Tanaman Jagung (*Zea mays* L.)," *Kultivasi*, vol. 18, no. 2, pp. 912–918, 2019.

[13] D. Kurniadie, U. Umiyati, and D. A. Ardhianty, "Efikasi Herbisida Campuran Tienkarbazon Metil 68 g/l dan Tembotrion 345 g/l Terhadap Gulma Berdaun Lebar dan Gulma Golongan Rumput Pada Budidaya Tanaman Jagung (*Zea mays* L.).," *J. Kultiv.*, vol. 20, no. 3, pp. 202–212, 2021.

[14] V. Sidharta, R. M. Tambunan, Azwar, and A. Ghaniyyu, "Suatu Kajian Pembangunan Pertanian Indonesia," *KAIS Kaji. Ilmu Sos.*, vol. 2, no. 2, pp. 229–232, 2021.

[15] W. E. Purnomo and S. Hasjim, "Efektivitas dan Selektivitas Beberapa Bahan Aktif Herbisida Untuk Mengendalikan Gulma pada Dua Varietas Tanaman Kacang Panjang (*Vigna sesquipedalis* L.)," *J. Prot. Tanam. Trop.*, vol. 1, no. 2, pp. 48–54, 2020.

[16] D. Guntoro and T. Y. Fitri, "Aktivitas Herbisida Campuran Bahan Aktif Cyhalofop-Butyl dan Penoxsulam terhadap Beberapa Jenis Gulma Padi Sawah," *Bul. Agrohorti*, vol. 1, no. 1, pp. 140–148, 2013.

[17] N. Alfredo, N. Sriyani, and D. Sembodo, "Efikasi Herbisida Pratumbuh Metil Metsulfuron Tunggal dan Kombinasinya dengan 2,4-D, Ametrin, Atau Diuron Terhadap Gulma pada Pertanaman Tebu (*Saccharum Officinarum* L.) Lahan Kering," *J. Agrotropika*, vol. 17, no. 1, pp. 29–34, 2018.

[18] R. Tri Fuadi and K. P. Wicaksono, "Aplikasi Herbisida Berbahan Aktif Atrazin dan Mesotrion terhadap Pengendalian Gulma dan Hasil Tanaman Jagung Manis (*Zea mays* L. Saccharata) Varietas Bonanza," *J. Produksi Tanam.*, vol. 6, no. 5, pp. 767–774, 2018.

[19] A. Wahyudin, R. Ruminta, and S. A. Nursaripah, "Pertumbuhan dan Hasil Tanaman Jagung (*Zea mays* L.) Toleran Herbisida Akibat Pemberian Berbagai Dosis Herbisida Kalium Glifosat," *Kultivasi*, vol. 15, no. 2, pp. 86–91, 2016.

[20] H. Karimmojeni *et al.*, "Competitive Ability Effects of Datura Stramonium l. And Xanthium Strumarium l. on the Development of Maize (*Zea mays*) Seeds," *Plants*, vol. 10, no. 9, 2021.

[21] J. Shrestha, K. P. Timsina, S. Subedi, D. Pokhrel, and A. Chaudhary, "Sustainable Weed Management in Maize (*Zea mays* L.) Production: A Review in Perspective of Southern Asia," *Türkiye Herboloji Derg.*, vol. 22, no. 1, pp. 133–143, 2019.

[22] Y. Sumekar, D. Riswandi, and D. Widayat, "Pengaruh Herbisida Atrazine + Nicosulfuron Terhadap Pengendalian Gulma dan Hasil Tanaman Jagung (*Zea mays* L.)," *J. Ilmu Pertan. dan Peternak.*, vol. 5, no. 5, pp. 190–197, 2017.

[23] N. S. Simanjuntak, E. Purba, and J. Ginting, "Pertumbuhan dan Produksi Jagung (*Zea mays* L.) Pada Berbagai Metode Pengendalian Gulma," *J. Online Agroekoteknologi*, vol. 2, no. 3, pp. 1055–1064, 2014.

[24] M. D. Faqihhudiin, Haryadi, and H. Purnamawati, “Penggunaan Herbisida IPA-Glifosat Terhadap Pertumbuhan, Hasil dan Residu pada Jagung,” *Ilmu Pertan.*, vol. 17, no. 1, pp. 1–12, 2014.
[25] R. P. Ginting, Syafrinal, and S. Yoseva, “Pengaruh Beberapa Bahan Aktif Herbisida pada Sistem Tanam Segitiga Terhadap Pertumbuhan dan Produksi Tanaman Jagung Manis (*Zea mays* var. saccharata Sturt.),” *Jom Faperta*, vol. 4, no. 2, pp. 1–15, 2017.
[26] A. Rahmi and Jumiati, “Pengaruh konsentrasi dan waktu penyemprotan pupuk organik cair Super ACI terhadap pertumbuhan dan hasil Jagung Manis,” *AGRITROP*, vol. 26, no. 3, pp. 105–109, 2007.
[27] D. Kurniadie, Y. Sumekar, and I. Buana, “Pengaruh Berbagai Jenis Surfaktan pada Herbisida Glufosinat Terhadap Pengendalian Gulma dan Hasil Tanaman Jagung (*Zea mays* L.) di Jatinagor,” *J. Kultiv.*, vol. 16, no. 2, pp. 378–381, 2017.