International Journal of Agriculture and Plant Science
www.agriculturejournal.in
Online ISSN: 2664-7664
Received: 30-11-2025, Accepted: 29-12-2025, Published: 13-01-2026
Volume 8, Issue 1, 2026, Page No. 45-49

Effect of a mixed herbicide of Ammonium glufosinate 120 g/L + 2,4-D dimethylamine 100 g/l on weed control in the circle area of immature oil palm (*Elaeis guineensis* Jacq.)

Yayan Sumekar, Intan Ratna Dewi Anjarsari, Angelia Christiani Munthe
Faculty of Agriculture, Universitas Padjadjaran, Indonesia

Abstract
Weed control in immature oil palm (TBM) plantations is a critical management practice to support optimal plant growth due to intense competition between weeds and the crop during this stage. This study aimed to evaluate the effectiveness and appropriate dosage of a mixed herbicide containing Ammonium Glufosinate 120 g/L and 2,4-D Dimethylamine 100 g/L for weed control in the circle area of immature oil palm plantations. The research was conducted from April to August 2025 at an oil palm plantation in Pakenjeng District, Garut Regency, West Java, using a randomized block design with seven treatments and four replications. Treatments consisted of five herbicide dosage levels (1.5, 2.0, 2.5, 3.0, and 3.5 L/ha), manual weeding, and an untreated control. Weed vegetation analysis prior to herbicide application was carried out using the Summed Dominance Ratio (SDR) method, while weed dry weight and phytotoxicity were observed at 4, 8, and 12 weeks after application (WAA). The results indicated that the dominant weed species at the study site were *Cyperus rotundus* L., *Stachytarpheta cayennensis*, and *Galinsoga quadriradiata*. Application of the mixed herbicide at all tested dosages effectively suppressed the dry weight of dominant weeds compared to manual weeding and the untreated control up to 12 WAA. Phytotoxicity observations showed that the mixed herbicide did not cause any toxic symptoms on immature oil palm plants. Therefore, the mixed herbicide of Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L is effective and safe for weed control in the circle area of immature oil palm plantations.

Keywords: Immature oil palm, mixed herbicide, Ammonium glufosinate, 2,4-D dimethylamine, weeds, dry weight, Phytotoxicity

Introduction

Oil palm (*Elaeis guineensis* Jacq.) is one of the most important plantation commodities widely cultivated in Indonesia due to its high economic value, particularly as a source of crude palm oil (CPO), which is utilized in food, pharmaceutical, cosmetic, and biofuel industries (Jatsiyah & Hermanto, 2020) [10]. According to the (Direktorat Jenderal Perkebunan, 2023) [6], Indonesia's oil palm plantation area reached 16,833,985 ha with a total production of 52,087,006 tons of palm oil in 2023. The rapid expansion of the oil palm industry represents a positive achievement that must be sustained to ensure long-term productivity and economic benefits.

One of the major constraints in increasing oil palm productivity is weed infestation, which competes with the crop for essential growth factors such as water, nutrients, light, and growing space, thereby inhibiting optimal plant growth (Andini *et al*., 2022) [2]. If weeds are not properly controlled, they can significantly reduce yield and quality, with reported yield losses in oil palm plantations ranging from 25% to 40% (Tolik *et al*., 2023) [20]. Therefore, effective weed management is a crucial component of oil palm cultivation.

Weed competition is particularly severe during the immature oil palm (TBM) phase. At this stage, the limited number and length of fronds allow greater penetration of sunlight to the soil surface, creating favorable conditions for weed growth (Umiyati & Kurniadie, 2018) [21]. Based on the study by (Purwasih *et al*., 2013) [14], the intensity of sunlight reaching the soil surface in immature oil palm (TBM) areas is 7.25%, whereas in mature oil palm (TM) areas it is only 1.32%. The higher light intensity in TBM areas is caused by the oil palm canopy not yet fully closing, allowing more sunlight to reach the soil surface. This condition results in greater weed growth during the TBM phase compared to the TM phase. The TM phase has a dense canopy with long fronds that bend downward, forming thick shade that inhibits light penetration to the soil surface and suppresses weed growth. In addition to the high level of competition between weeds and oil palm plants during the TBM phase, soil conditions have not yet developed good physiological strength, making immature oil palm more vulnerable and easily influenced by environmental factors (Umiyati & Kurniadie, 2018) [21]. This indicates that weed control in immature oil palm plantations needs to be carried out more intensively.

Various weed control methods can be applied to reduce weed populations, one of which is chemical control through herbicide application. Weed control using herbicides is considered more efficient and effective compared to other weed control methods because it requires lower costs, less time, and less labor, and is especially capable of reaching wider plantation areas (Jumantoro *et al*, 2024) [11]. In general, herbicide application uses only one type of active ingredient; however, repeated use of a single active ingredient herbicide has the potential to cause weed resistance and reduce herbicide effectiveness (Nopiansyah *et al*., 2021) [13]. The mixing of two types of herbicides with different mechanisms of action is an appropriate strategy to increase efficacy and prevent the occurrence of resistance (Andini *et al*., 2022) [2].

An herbicide that can be used to control weeds in immature oil palm plantations is a mixed herbicide of Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L, which has different mechanisms of action. Ammonium Glufosinate is a non-selective contact herbicide used to control grasses,

broadleaf weeds, and sedges with a broad spectrum (Pujisiswanto *et al*., 2022) [15]. Ammonium Glufosinate works by inhibiting the formation of glutamine from glutamate, which plays a role in ammonia (NH_4^+) detoxification, resulting in ammonia accumulation reaching toxic levels in leaf chloroplasts, inhibiting the photosynthesis process, and ultimately causing weed death (Reza *et al*., 2016) [17]. 2,4-D Dimethylamine is a systemic and selective herbicide used to control broadleaf weeds, sedges, and grasses (Maulana *et al*., 2023) [12]. The herbicide 2,4-D Dimethylamine works as an auxin transport inhibitor that suppresses auxin hormone activity in cell division, differentiation, and cell elongation, thereby disrupting normal weed growth, which subsequently results in gradual plant death due to disrupted water and nutrient absorption by roots, inhibited photosynthesis, and blockage of phloem transport (Arpiansyah *et al*., 2023) [3].

The objective of this study was to determine the effectiveness of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L in controlling weeds in the circle area of immature oil palm (TBM) plantations.

Material and Methods

The research was conducted from April to August 2025 at an oil palm plantation in Pakenjeng District, Garut Regency, West Java Province. The materials used in this study included three-year-old immature oil palm plants (TBM) of the Simalungun variety, a mixed herbicide of Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L, ZA fertilizer, TSP, MOP, and kieserite fertilizer. The equipment used included a semi-automatic backpack sprayer with a T-jet nozzle, measuring cylinders, pipettes, hoes, sickles, 0.5 m × 0.5 m quadrats, scissors, plastic bags, labels, envelopes, an oven, a balance, stationery, and documentation tools.

The experimental method used was a Randomized Block Design (RBD) with seven treatments and four replications. Treatments A–E consisted of different dosage levels of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L, namely A: 1.5 L/ha; B: 2.0 L/ha; C: 2.5 L/ha; D: 3.0 L/ha; and E: 3.5 L/ha. Treatment F was manual weeding, and treatment G was the control or without weed control. Data analysis was carried out using analysis of variance, and if the treatments showed a significant effect, it was followed by further testing to compare differences among treatment means at a 5% significance level.

Weed vegetation analysis was conducted prior to application using the calculation of the Summed Dominance Ratio (SDR) to determine the composition and dominance of weeds in the circle area of immature oil palm (TBM). Observations of weed dry weight and phytotoxicity were conducted at 4, 8, and 12 weeks after application (WAA). Weed samples were taken from two quadrats measuring 0.5 m × 0.5 m by cutting weeds above the soil surface, then separated according to species. The samples were subsequently dried in an oven at a temperature of 80°C for 48 hours or until a constant dry weight was achieved and then weighed. Phytotoxicity observations were conducted to ensure that the herbicide did not cause negative effects on the main crop.

Results and Discussion

Weed Vegetation Analysis

The results of weed vegetation analysis prior to the application of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethylamine 100 g/L are presented in Table 1. Based on the results of the weed vegetation analysis, it was found that the weed community at the study site consisted of broadleaf weeds, grasses, and sedges. The Summed Dominance Ratio (SDR) value indicates the level of dominance of each weed species over the growing environment in the study area (Budi, 2018) [4]. The weeds *Cyperus rotundus* L., *Stachytarpheta cayennensis*, and *Galinsoga quadriradiata* had the highest SDR values, indicating that these three species were not only widely distributed throughout the sampling plots but also had a significantly higher number of individuals compared to other weed species.

Table 1: Composition of Dominant Weeds

Weed Species	Group	SDR (%)
Grona triflora	Broadleaf	8,76
Galinsoga quadriradiata	Broadleaf	10,27
Cyperus rotundus L.	Sedge	12,19
Trachelospermum asiaticum	Broadleaf	7,97
Stachytarpheta jamaicensis L.	Broadleaf	10,44
Urena lobata	Broadleaf	8,34
Richardia brasiliensis	Broadleaf	4,83
Chromolaena odorata L.	Broadleaf	5,22
Spermacoce remota	Broadleaf	6,09
Cynodon dactylon	Grass	10,44
Oxalis barrelieri L.	Broadleaf	6,71
Pueraria phaseoloides	Broadleaf	8,77
Total		100

Dry Weight of *Cyperus rotundus L.* Weeds

The results of observation and analysis of variance on the effect of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethyl Amine 100 g/L at application rates of 1.5 L/ha to 3.5 L/ha on the dry weight of *Cyperus rotundus* L. weeds are presented in Table 2. The application of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethyl Amine 100 g/L at rates of 1.5–3.5 L/ha resulted in lower dry weight of *Cyperus rotundus* L. and showed significant differences compared to manual weeding and the untreated control. *Cyperus rotundus* L. is a weed species commonly found and considered a dominant weed in immature oil palm (TBM) plantations due to its wide distribution and highly competitive ability with the main crop (Susanti *et al*, 2021) [18].

The application of Ammonium Glufosinate 200 g/L has been reported to effectively control total weeds, grass weeds, broadleaf weeds, and dominant weeds over large-scale oil palm plantation areas during the immature phase up to 12 weeks after application (WAA) (Umiyati & Kurniadie, 2018) [21]. *Cyperus rotundus* L. is also known to be sensitive to synthetic auxin herbicides such as 2,4-D, which act by disrupting hormonal balance and damaging vascular tissues of weeds, thereby inhibiting growth and regeneration from (Rao, 2000) [16]. Therefore, the combination of active ingredients Ammonium Glufosinate + 2,4-D has the potential to provide more effective control of *Cyperus rotundus* L. during the immature oil palm phase, as reflected by the lower weed dry weight and significant differences compared to manual weeding and the control treatment.

Table 2: Effect of Herbicide Application on the Dry Weight of *Cyperus rotundus* L. Weeds

Treatment	Dosage l/ha	Dry Weight (g)		
		4 WAA	8 WAA	12 WAA
A Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	1,5	0,22 a	0,00 a	2,17 ab
B Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,0	0,73 ab	1,37 a	4,59 bc
C Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,5	0,53 ab	1,67 a	0,00 a
D Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,0	0,44 ab	1,15 a	0,67 ab
E Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,5	0,08 a	0,35 a	0,00 a
F Manual weeding	-	1,00 b	2,15 b	7,01 cd
G Control	-	2,14 c	6,85 c	11,30 d

Note: Mean values followed by the same letter in the same coloumn are not significantly different at the 5% level according to Duncan's Multiple Range Test (DMRT). WAA = Weeks After Application.

Bobot Kering Gulma *Stachytarpheta jamaicensis* (L.)

The results of observations and analysis of variance on the effect of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D Dimethyl Amine 100 g/L applied at rates of 1.5 L/ha to 3.5 L/ha on the dry weight of *Stachytarpheta jamaicensis* (L.) are presented in Table 3. The dry weight of *Stachytarpheta jamaicensis* (L.) in this study showed significantly different responses, where the application of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L was able to significantly suppress weed biomass growth compared to manual weeding and the control treatment. The reduction in dry weight indicates the effectiveness of the herbicide in inhibiting biomass accumulation of *Stachytarpheta jamaicensis* (L.) during observations at 4, 8, and 12 weeks after application (WAA). The herbicide 2,4-D is highly effective and more efficient in suppressing the growth of broadleaf weeds in oil palm plantations by accelerating weed respiration, which ultimately leads to weed mortality (Afrianti, 2019) [1].

Stachytarpheta jamaicensis (L.) is a broadleaf weed with a high regenerative capacity through generative reproduction, namely seed dispersal by wind, allowing this species to adapt easily and spread widely under cultivated land conditions (Solikin, 2016) [19]. Therefore, the suppression of dry weight of *Stachytarpheta jamaicensis* (L.) through herbicide application in this study highlights the important role of chemical weed control in weed management of immature oil palm plantations (TBM).

Table 3: Effect of Herbicide Application on the Dry Weight of Stachytarpheta jamaicensis (L.)

Treatment	Dosage l/ha	Dry Weight (g)		
		4 WAA	8 WAA	12 WAA
A Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	1,5	0,94 ab	0,00 a	0,00 a
B Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,0	0,10 a	0,34 ab	0,00 a
C Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,5	0,02 a	0,03 a	0,03 a
D Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,0	0,62 ab	0,30 ab	1,14 a
E Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,5	0,11 a	0,00 a	0,00 a
F Manual weeding	-	2,23 bc	1,48 b	5,69 b
G Control	-	3,94 c	4,03 c	7,72 b

Note: Mean values followed by the same letter in the same coloumn are not significantly different at the 5% level according to Duncan's Multiple Range Test (DMRT). WAA = Weeks After Application.

Dry Weight of *Galinsoga quadriradiata* Weeds

The results of observation and analysis of variance on the effect of a mixed herbicide of Ammonium Glufosinate 120 g/L + 2,4-D Dimethyl Amine 100 g/L at doses of 1.5–3.5 L/ha on the dry weight of *Galinsoga quadriradiata* weeds are presented in Table 3. The dry weight of *Galinsoga quadriradiata* showed a significant effect among treatments, where the application of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L resulted in lower dry weight compared to manual weeding and control treatments. Differences in response indicate that *Galinsoga quadriradiata* has varying levels of sensitivity to weed control methods, particularly chemical control, which works by inhibiting the growth of active weed tissues. The application of mixed herbicides with two active ingredients is more practical and profitable compared to other weed control methods in suppressing weed growth in immature oil palm plantations (TBM) (Dhini, 2022) [5].

Table 4: Effect of Herbicide Application on the Dry Weight of *Galinsoga quadriradiata* Weeds

Treatment	Dosage l/ha	Dry Weight (g)		
		4 WAA	8 WAA	12 WAA
A Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	1,5	0,53 b	1,97 ab	0,84 a
B Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,0	0,00 a	2,58 ab	0,00 a
C Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,5	0,02 a	0,00 a	0,00 a
D Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,0	0,00 a	0,00 a	0,15 a
E Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,5	0,00 a	0,00 a	0,00 a
F Manual Weeding	-	0,04 a	4,19 bc	1,50 a
G Control	-	1,01 c	7,68 c	7,11 b

Note: Mean values followed by the same letter in the same coloumn are not significantly different at the 5% level according to Duncan's Multiple Range Test (DMRT). WAA = Weeks After Application.

Phytotoxicity

The results of observation and analysis of variance on the effect of a mixed herbicide of Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L at doses of 1.5–3.5 L/ha on phytotoxicity in oil palm plants are presented in Table 5. Phytotoxicity refers to plant damage caused by exposure to certain chemical substances, such as herbicide application (Hastuti, 2021) [9]. bservations showed that immature oil palm plants (TBM) did not exhibit symptoms of poisoning, such as changes in leaf color, abnormal leaf shape, or disturbances in vegetative growth, across all treatments of the mixed herbicide Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L at doses of 1.5–3.5 L/ha. The application of the mixed herbicide Ammonium Glufosinate and 2,4-D was carried out according to the recommended dosage and appropriate application techniques to minimize the occurrence of phytotoxicity. Improper herbicide use, such as application beyond recommended doses or at inappropriate times, may increase the risk of crop injury even in tolerant plants (Ganie & Jhala, 2017) [7].

Table 5: bservation of Phytotoxicity in Oil Palm Plants

Treatment	Dosage l/ha	Observation		
		4 WAA	8 WAA	12 WAA
A Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	1,5	0	0	0
B Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,0	0	0	0
C Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	2,5	0	0	0
D Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,0	0	0	0
E Ammonium Glufosinate 120 g/L + 2,4-D 100 g/L	3,5	0	0	0
F Manual weeding	-	0	0	0
G Control	-	0	0	0

Note: WAA = Weeks After Application.

Conclusion

The application of a mixed herbicide consisting of Ammonium Glufosinate 120 g/L + 2,4-D Dimethyl Amine 100 g/L at doses of 1.5–3.5 L/ha was proven to be effective in suppressing the growth of dominant weeds in immature oil palm plantations (TBM). This effectiveness was indicated by the low dry weight of *Cyperus rotundus* L., *Stachytarpheta cayennensis*, and *Galinsoga quadriradiata* compared to manual weeding and control treatments. All mixed herbicide treatments did not cause phytotoxic symptoms in immature oil palm plants throughout the observation period. Therefore, the mixed herbicide Ammonium Glufosinate + 2,4-D Dimethyl Amine can be recommended as an effective and safe weed control method during the immature phase of oil palm cultivation.

References

1. Afrianti S, Parinduri S, Aditya C. Efektivitas Pencampuran Herbisida Glifosat dengan 2,4-D Terhadap Pengendalian Gulma Berdaun Sempit dan Gulma Berdaun Lebar Pada Perkebunan Kelapa Sawit (*Elaeis guineensis* Jacq). Agroprimatech,2017:1(1):1–9.
2. Andini FD, Pujisiswanto H, Susanto H, Sriyani N, Sembodo DRJ. Uji Sifat Campuran Herbisida 2,4-D Dimetil Amina dan Isopropilamina Glifosat terhadap Gulma *Cyperus kyllingia*, *Borreria alata*, dan *Axonopus compressus*. Jurnal Agrotek Tropika,2022:10(4):645–650.
3. Arpiansyah E, Mawandha HG, Tarmadja S. Efektivitas Beberapa Herbisida Sistemik dan Perlakuan Pembabatan Terhadap Gulma *Scleria sumatrensis* di Kebun Kelapa Sawit. Agroforetech,2023:1(3):1499–1504.
4. Budi GP. Analisis Vegetasi dan Penentuan Dominansi Gulma Pada Pertanaman Jagung di Beberapa Ketinggian Tempat. Agritech,2018:(1):13–18.
5. Dhini ENR, Sarbino, Syahputra E. Aktivitas Herbisida Campuran Glifosat dan 2,4-D Amina Terhadap Kentosan. Jurnal Sains Pertanian Equator, 2022, 265–272.
6. Direktorat Jenderal Perkebunan. Buku Statistik Perkebunan 2023-2025. Jakarta: Direktorat Jenderal Perkebunan, 2023.
7. Ganie ZA, Jhala AJ. Interaction of 2,4-D or Dicamba With Glufosinate for Control of Glyphosate-Resistant Giant Ragweed (*Ambrosia trifida* L.) in Glufosinate-Resistant Maize (*Zea mays* L.). Frontiers in Plant Science,2017:8(7):1–10.
8. Harahap WU, Lubis W, Nurhajijah. Identifikasi Jenis dan Nilai Summed Dominance Ratio (SDR) Gulma di Lahan Kering. Radikula: Jurnal Ilmu Pertanian, 1(1), 20–25.
9. Hastuti D. Pengendalian gulma jajagoan (*Echinochloa crus-galli*) dengan herbisida nabati dari ekstrak daun tembelekan (*Lantana camara*). Jurnal Ilmu Pertanian Tirtayasa,2021:13(2):327–338.
10. Jatsiyah V, Hermanto SR. Efikasi Herbisida Isopropilamina Glifosat terhadap Pengendalian Gulma Kelapa Sawit Belum Menghasilkan. Agrovigor,2020:13(1):22–28.
11. Jumantoro D, Mu'in A, Mawandha HG. Berbagai Cara Pengendalian Gulma Anak Kayu dan Anak Sawit pada Kebun Kelapa Sawit dengan Cara Mekanis dan Kimiawi. Agroforetech,2024:2(3):1352–1358.
12. Maulana A, Susanto H, Pujisiswanto H, Sriyani N. Uji Sifat Campuran Herbisida Berbahan Aktif 2,4-D Dimetil Amina+Isopropilamina Glifosat terhadap Gulma *Ottochloa nodosa*, *Cyperus rotundus*, dan *Praxelis clematidea*. Jurnal Penelitian Pertanian Terapan,2023:23(1):64–72.
13. Nopiansyah, Syaputra E, Sarbino. Keefektifan Beberapa Herbisida Campuran Dalam Mengendalikan Gulma Umum Perkebunan Kelapa Sawit. Perkebunan dan Lahan Tropika,2021:2(11):96–103.
14. Purwasih SD, Sarbino, Rahmidiyani. Struktur Komunitas Gulma Pada Kebun Peremajaan Kelapa Sawit di Lahan Gambut PT. Bumi Pratama Khatulistiwa (BPK), Kubu Raya. Jurnal Universitas Tanjungpura, 2013, 1–11.
15. Pujisiswanto H, Susanto H, Saputra RA. Efikasi Herbisida Amonium Glufosinat untuk Pengendalian

Gulma pada Tanaman Kelapa Sawit (*Elaeis guineensis* Jacq.) Menghasilkan. Jurnal Agrotek Tropika,2022:10(2):301–307.
16. Rao. Principles of Weed Science, 2nd ed. USA: Science Publishers, 2000.
17. Reza RMI, Meiriani, Purba E. Pengendalian Gulma dengan Amonium Glufosinat pada Pertanaman Tomat (*Solanum lycopersicum* L.). Jurnal Online Agroteknologi,2016:8(1):103–109.
18. Susanti ED, Hera N, Zam SI. Perbandingan Vegetasi Gulma pada Perkebunan Kelapa Sawit (*Elaeis guineensis* Jacq.) Menghasilkan dan Belum Menghasilkan di Lahan Gambut. Jurnal Agroteknologi,2021:12(1):17–24.
19. Solikin. Keragaman Spesies Tumbuhan Sebagai Asosian Pada Tempat Tumbuh *Stachytarpheta jamaicensis* (L.) Vahl di Pulau Kepala Jeri dan Pemping Batam. Balai Konservasi Tumbuhan, 9(2), 83–92.
20. Tolik M, Afrillah M, Alfides H. Manajemen Pengendalian Gulma Tanaman Kelapa Sawit (*Elaeis guineensis* Jacq.) Di PT. ASN Kebun Tanoh Makmue Aceh Barat. Biofarm: Jurnal Ilmiah Pertanian,2023:19(1):125–130.
21. Umiyati U, Kurniadie D. Pengendalian Gulma Umum dengan Herbisida Campuran (Amonium Glufosinat 150 g/l dan Metil Metsulfuron 5 g/l) Pada Tanaman Kelapa Sawit TBM. Jurnal Penelitian Kelapa Sawit,2018:26(1):29–35.