

Effect of Ammonium glufosinate 150 g/L herbicide on weeds in the cultivation immature oil palm (*Elaeis guineensis* Jacq.) plantations

Yayan Sumekar, Intan Ratna Dewi Anjarsari, Julia Prameswari

Faculty of Agriculture, Universitas Padjadjaran, Jalan R. Jatinangor, West Java, Indonesia

Abstract

Weed control in the immature phase of oil palm cultivation is very important to ensure optimal growth in the future. This study aims to evaluate the effectiveness of 150 g/L ammonium glufosinate herbicide in controlling weeds in immature oil palm plantations and its impact on the main crop. The study was conducted in Garut, West Java, using a Randomized Block Design (RBD) with seven treatments and four replicates. The treatments consisted of five levels of ammonium glufosinate dosage (1.5, 2.0, 2.5, 3.0, and 3.5 L/ha), manual weeding, and control. The parameters observed included vegetation analysis (SDR), dry weight of weeds at 4, 8, and 12 WAA, and symptoms of phytotoxicity in oil palm plants. The results showed that the application of ammonium glufosinate at a dose of 1.5–3.5 L/ha was effective in controlling total weeds, dominant broadleaf weeds (*Stachytarpheta jamaicensis*) and grass weeds (*Digitaria sanguinalis*) for up to 12 WAA. A dose of 2.5 L/ha was identified as the most optimal dose in suppressing total dry weight of weeds and providing efficacy equivalent to or better than manual weeding. All herbicide doses tested did not cause phytotoxicity symptoms on the stems, leaves, or fronds of oil palms, making them safe for use in the immature phase. In conclusion, ammonium glufosinate 150 g/L herbicide is an effective and efficient alternative for weed control without damaging the main crop.

Keywords: Ammonium glufosinate 150 g/l, palm oil, efficacy, phytotoxicity

Introduction

Oil palm (*Elaeis guineensis* Jacq.) is one of the strategic agricultural commodities that supports Indonesia's economy. As the world's largest producer of palm oil, Indonesia supplies around 55% of total global production (Wahyudi *et al.*, 2024) [24], with production projections according to the United States Department of Agriculture (2025) [2] reaching 46 million metric tons (MT) in 2024–2025. The palm oil sector contributes significantly to the national economy, requiring proper management and maintenance to ensure sustainable productivity (Lubis *et al.*, 2022) [7]. However, national palm oil productivity currently faces serious challenges. Data shows that the increase in oil palm plantation area over the last ten years (4.83%) has not been accompanied by a commensurate increase in productivity, which is only around 0.93% (PDSIP, 2024) [1].

One critical factor that determines productivity in the crop production phase (TM) is the quality of management in the pre-production phase (TBM). Improper management during the immature phase, especially in controlling pests, diseases, and weeds, can inhibit plant growth and production potential (Prasetyo and Zaman, 2016; Tolik *et al.*, 2023) [9, 19]. A significant challenge in oil palm plantation management is the presence of weeds. Weeds that are not properly managed will compete with oil palms for nutrients, water, and sunlight. Weeds also often serve as hosts for pests and diseases that have the potential to damage the main crop (Winarna *et al.*, 2022) [25]. Weed control, especially during the TBM phase of oil palm, needs to be done properly because during this phase the space between plants is quite open as the canopy has not yet closed (Ugot *et al.*, 2022) [21]. This causes weeds to grow quite dominantly in the area.

Weed infestation in oil palm plantations can reduce yields by 25-40% (Tolik *et al.* 2023) [19]. Controlling oil palm plants that are not yet producing requires 50% to 70% of the total cost of plant pest control (Sianturin, 2001) [14]. Of the

many weed control techniques available, herbicides are often used to control weed infestations because they are easy, fast, time-saving, cost-effective, and the most reliable method of weed control (Singh *et al.*, 2020) [15]. The success of herbicide uses for weed control is determined, among other things, by the selection of the appropriate type or active ingredient of the herbicide (Purnomo and Hasjim, 2020) [11]. The type of active ingredient in the herbicide and the concentration of the solution used will affect the effectiveness of weed control. Weed control in oil palm plantations generally still relies on herbicides with the active ingredients paraquat and glyphosate, which are the main choices because they are considered effective (Pujisiswanto, *et al.* 2022) [10]. Long-term dependence on these herbicides has the potential to cause serious problems, such as resistance. According to Tampubolon and Purba (2018) [17], the weeds *Eleusine indica* (jampang) and *Amaranthus spinosus* (bayam duri) have developed resistance to glyphosate.

Ammonium glufosinate is one potential alternative with a different mechanism of action. Ammonium glufosinate is a contact, systemic, and non-selective herbicide used to control annual and seasonal broadleaf weeds, sedges, and grass weeds (Chompoo and Pornprom, 2008) [4]. Its mode of action is to inhibit the synthesis of glutamine from glutamate, which is necessary for the detoxification of ammonia (NH₄⁺), causing ammonia to increase to toxic levels in the chloroplasts within the leaf tissue, which stops photosynthesis and kills the weeds (Tomlin, 1997) [20].

Information regarding the effectiveness of ammonium glufosinate on various types of weeds in immature phase oil palm plantations is still limited. The optimal dose of ammonium glufosinate at 150 g/l to control weeds without causing phytotoxicity symptoms in immature oil palm plants has not been specifically studied. Based on the above description, it is necessary to conduct field trials on the

effects and appropriate and efficient dosage of ammonium glufosinate herbicide in suppressing weed growth in oil palm plantations without causing phytotoxicity.

Materials and Methods

The research was conducted from April to August 2025. It was carried out at a palm oil plantation in the Pakenjeng District, Garut Regency, West Java Province. The study used three-year-old young oil palm plants (TBM) of the Simalungun variety. The herbicide included Ammonium Glufosinate at 150 grams per liter. Fertilizers used were ZA, TSP, MOP, and kieserite. The tools included a semi-automatic backpack sprayer with a T-jet nozzle, measuring cylinders, pipettes, hoes, sickles, 0.5 meter by 0.5-meter quadrats, scissors, plastic bags, labels, envelopes, an oven, a balance, paper supplies, and items for record keeping. The experiment used a randomized block design with 7 different treatments and 4 replicates. The treatments included ammonium glufosinate herbicide at 150 g/L, applied in five different doses: 1.5 L/ha, 2 L/ha, 2.5 L/ha, 3 L/ha, and 3.5 L/ha, along with manual weeding and a control group with no treatment. The data was analyzed using analysis of variance. If the treatments had a significant effect, then mean separation tests were done on the treatment averages at a 95% confidence level. Before applying the herbicide, vegetation was analyzed using a quadrant method with a 0.5 m x 0.5 m area. Weeds in the experimental plot were observed and recorded. Weed samples were collected to get data on their biomass, density, and frequency. This data was used to calculate the Sum Dominance Ratio (SDR) to assess the vegetation.

After the treatment, weeds were observed at 4, 8, and 12 weeks after application. In each observation, weed samples were collected from the same 0.5 m x 0.5 m quadrant area. The samples were sorted by weed type and then dried in an oven at 80°C for 48 hours or until they reached a constant weight. The dry weight of the samples was then measured. Phytotoxicity observations were conducted to ensure that the herbicide did not cause negative effects on the main crop.

Result and Discussion

Weed Vegetation Analysis

Weed vegetation analysis is very important in determining weed dominance in an area as a basis for weed control. Weed vegetation analysis is carried out by calculating the SDR value in each experimental plot. An SDR percentage of more than 10% indicates that the weed is dominant (Kurniadie., 2022) [6]. In the third year of oil palm cultivation, six broadleaf weed species, one grass weed species, and one sedge weed species were found. Vegetation analysis was based on the Summed Dominance Ratio (SDR) value, which reflects the relative contribution of each species to the ecosystem. Table 1 shows that *Stachytarpheta jamaicensis* had the highest SDR value of 20.64% as the dominant weed, followed by *Digitaria sanguinalis* with a value of 15.21% and *Cyperus rotundus* with 13.08% as co-dominant weeds. The dominance of broadleaf weeds occurs because of their tough characteristics. Broadleaf weeds have a taproot system that makes them more sturdy than grass weeds and creeping weeds, so broadleaf weeds are more dominant on the land (Jumatang *et al.*, 2020) [5].

Table 1: Weed Vegetation Analysis

No.	Species	Local Name	Family	Group	SDR (%)
1	<i>Stachytarpheta jamaicensis</i>	Pecut kuda	Verbenaceae	Broadleaf	20,64
2	<i>Ageratum conyzoides</i>	Bandotan	Asteraceae	Broadleaf	12,11
3	<i>Digitaria sanguinalis</i>	Jampang	Poaceae	Grass	15,21
4	<i>Synedrella nodiflora</i>	Gletang	Asteraceae	Broadleaf	12,50
5	<i>Centrosoma pubescens</i>	Sentro	Fabaceae	Broadleaf	8,24
6	<i>Cyperus rotundus</i>	Teki ladang	Cyperaceae	Sedge	13,08
7	<i>Chromolaena odorata</i>	Kirinyuh	Asteraceae	Broadleaf	6,69
8	<i>Urena lobata</i>	Pulutan	Malvaceae	Broadleaf	11,53
Total					100

Dry Weight of *Stachytarpheta jamaicensis* Weeds

The results presented in table 2, indicate that the herbicide ammonium glufosinate at a concentration of 150 g/L applied at a dose of 1.5–3.5 L/ha on the dry weight of *Stachytarpheta jamaicensis* weeds showed a significant treatment effect, producing the lowest dry weight of weeds compared to the control treatment. *Stachytarpheta jamaicensis* is a broadleaf weed belonging to the Verbenaceae family. This broadleaf weed has a greater ability to absorb nutrients,

allowing the dominant weed with the highest SDR value to overcome other weeds (Tanasale 2022) [18]. At 12 weeks after application (WAA), these doses were able to suppress weed dry weight to near or even 0.00 g, indicating that these doses are effective in providing optimal and sustainable weed control. These significant results are due to the inhibition of glutamine synthesis, which is necessary for ammonia detoxification, causing ammonia to increase to toxic levels in the chloroplasts of leaf tissue (Takano 2020; Umiyati 2018) [16, 22].

Table 2: Average Dry Weight of *Stachytarpheta jamaicensis*

Treatment	Dosage (L/ha)	Average Weight of Weeds			
		4 WAA	8 WAA	12 WAA	
A	Amonium Glufosinat 150 g/L	1.5	0,08 a	3,62 a	0,00 a
B	Amonium Glufosinat 150 g/L	2.0	0,90 a	0,51 a	0,25 a
C	Amonium Glufosinat 150 g/L	2.5	0,00 a	0,86 a	0,00 a
D	Amonium Glufosinat 150 g/L	3	0,00 a	0,33 a	0,00 a
E	Amonium Glufosinat 150 g/L	3.5	0,83 a	1,48 a	0,00 a
F	Manual Weeding	-	0,77 a	4,29 a	4,70 b
G	Control	-	5,10 b	23,32 b	13,75 c

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 *Digitaria sanguinalis* Weeds

Digitaria sanguinalis is a narrow leaf weed, which is a type of grass, and it belongs to the Poaceae family. The Poaceae family has the most weed species found at the research site because these weeds can grow in different types of soil, with varying pH levels, and in different crops, including immature oil palm plantations. These plantations have high sunlight and soil that is not too wet. Based on the results in table 3, all herbicide

treatment doses were effective in controlling the weed *Digitaria sanguinalis* from 4 WAA up to 12 WAA. All treatments can be considered effective because they showed a significant difference from the control and were better than manual weeding. This is in line with Pujisiswanto's (2022) [22] research, which found that ammonium glufosinate is effective in controlling grass and broadleaf weeds due to its nonselective nature and is used to control weeds on a large scale.

Table 3: Average Dry Weight of *Digitaria sanguinalis*

Treatment	Dosage (L/ha)	Average Weight of Weeds			
		4 WAA	8 WAA	12 WAA	
A	Amonium Glufosinat 150 g/L	1.5	0,00 a	0,42 a	0,00 a
B	Amonium Glufosinat 150 g/L	2.0	0,06 a	0,00 a	0,00 a
C	Amonium Glufosinat 150 g/L	2.5	0,00 a	0,00 a	0,00 a
D	Amonium Glufosinat 150 g/L	3	0,17 ab	0,00 a	0,00 a
E	Amonium Glufosinat 150 g/L	3.5	0,00 a	0,00 a	0,00 a
F	Manual Weeding	-	0,08 a	0,00 a	1,02 a
G	Control	-	0,46 b	1,21 b	2,82 b

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

Total dry weight of weeds

Total dry weight of weeds is the constant dry weight of all weed species growing and found in the experimental field during the observation period. Based on the results of the analysis of variation in total dry weight of weeds, it can be seen that the treatment dose of 150 g/L of ammonium glufosinate herbicide had a significant effect on the total dry weight of weeds in weeks 4, 8, and 12 (as shown in table 4), that treatment with a dose of 1.5–3.5 L/ha was effective in controlling total weeds in TBM oil palm plantations because it had a significantly different notation from the control treatment. However, among all treatments tested at each

observation, treatment C with a dose of 150 g/L of ammonium glufosinate herbicide at 2.5 l/ha was the best dose for suppressing weed growth because it reduced dry weight to a level lower than that of the control treatment and manual weeding, as stated by Ugot (2022) [21] that weed control can be considered effective when the weed biomass in the herbicide treatment is relatively the same as the manual weeding treatment and lighter than the control, then it can control weeds up to 12 MSA. These results are in line with research by Pujisiswanto *et al.* (2022) [22], which states that ammonium glufosinate herbicide at 150 g/l is effective in controlling total weeds in oil palm plants up to 12 MSA.

Table 4: Total dry weight of weeds

Treatment	Dosage (L/ha)	Average Weight of Weeds			
		4 WAA	8 WAA	12 WAA	
A	Amonium Glufosinat 150 g/L	1.5	1,55 a	3,62 a	2,99 a
B	Amonium Glufosinat 150 g/L	2.0	1,50 a	0,51 a	0,25 a
C	Amonium Glufosinat 150 g/L	2.5	0,00 a	0,86 a	0,00 a
D	Amonium Glufosinat 150 g/L	3	0,47 a	0,33 a	0,91 a
E	Amonium Glufosinat 150 g/L	3.5	1,45 a	1,48 a	0,99 a
F	Manual Weeding	-	1,28 a	4,29 a	7,94 b
G	Control	-	11,48 b	23,32 b	38,16 c

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

Phytotoxicity of TBM oil palm plants

The results in Table 5 show that there was no phytotoxicity at 4, 8, and 12 WAA, as seen in the assessment results, which were not significantly different. These results show that applying ammonium glufosinate herbicide at 150 g/L, from the lowest to highest dose, did not cause any visible damage to the plants. This can be seen from the visual observations and toxicity scores in Table 8, which were all 0 phytotoxicity. During the experiment, no signs of phytotoxicity were found on the leaves, stems, or fronds of the oil palm plants, so it can be said that their growth and

fruit production will not be affected. This happened because the herbicide was applied in a way that avoided contact with the oil palm plants and focused only on the weeds. This is in line with Avun in Umiyati (2019) [23], who said that herbicides should be applied to increase contact with weeds and minimize contact with the main plant. Ugot (2022) [21] said that weed control is effective when phytotoxicity is low. These results are also consistent with the findings of Girsang (2023) [3], that 200 g/L ammonium glufosinate at all tested doses (2.6 l/ha, 2.8 l/ha, 3.0 l/ha, 3.2 l/ha, and 3.4 l/ha) did not harm oil palm plants.

Table 5: Phytotoxicity

Treatment	Dosage (L/ha)	Phytotoxicity		
		4 WAA	8 WAA	12 WAA
A	Amonium Glufosinat 150 g/L	1.5	0	0
B	Amonium Glufosinat 150 g/L	2.0	0	0
C	Amonium Glufosinat 150 g/L	2.5	0	0
D	Amonium Glufosinat 150 g/L	3	0	0
E	Amonium Glufosinat 150 g/L	3.5	0	0
F	Manual Weeding	-	0	0
G	Control	-	0	0

WAA = Weeks After Application

Conclusion

Based on the results of the experiment, it was found that ammonium glufosinate herbicide 150 g/L at a dose of 1.5, 2.0, 2.5, 3, and 3.5 L/ha was effective in controlling total weeds, dominant broadleaf weeds (*Stachytarpheta jamaicensis*) and grass weeds (*Digitaria sanguinalis*) for up to 12 weeks after application. The treatment with a dose of 2.5 L/ha was the best dose for reducing the total dry weight of weeds compared to other treatments and manual weeding, as indicated by weed dry weights approaching 0.00 g. All herbicide doses tested (up to 3.5 L/ha) were proven to be safe and did not cause phytotoxicity (damage) to the stems, leaves, or fronds of immature oil palm plants.

References

- [PDSIP] Pusat Data Dan Sistem Informasi Pertanian. Outlook Komoditas Perkebunan Kelapa Sawit. Kementerian Pertanian Republik Indonesia, 2024.
- [USDA] United States Department of Agriculture. Palm Oil Production 2024-2025. United State Department of Agriculture, 2025.
- Girsang W, Girsang R, Zamriyetti Renizuida, Hutagalung Y. The Effectiveness of Fluroxypyr Meptyl And Ammonium Glufosinate Herbicide in Controlling Weeds in The Field Oil Palm (*Elaeis guineensis* Jacq.). Journal of Research in Science Education, 2023.
- J Chompoo, T Pornprom. Rt-Pcr Based Detection of Resistance Conferred by An Insensitive Gs In Glufosinate-Resistant Maize Cell Lines. Pesticide Biochem. Physiol, 2008;90:189-195.
- Jumatang, Elis Tambaru, Masniawati A. Identifikasi Gulma Di Lahan Tanaman Talas Jepang *Colocasia esculenta* L. Schott Var. Antiquorum Di Desa Congko Kecamatan Marioriwawo Kabupaten Soppeng. Jurnal Biologi Makasar, 2020;5(1):69-78.
- Kurniadie D, Widayat D, Dan Sernita PI. Pengaruh Dosis Herbisida Isopropilamina Glifosat 480 Sl Untuk Pengendalian Gulma Pada Budidaya Tanaman Eukaliptus (*Eucalyptus* Sp.). Jurnal Agrikultura, 2022; 33(2):208-216.
- Lubis RE, Purba AR, Caliman JP. Best Management Practices Kelapa Sawit. Pusat Penelitian Kelapa Sawit, 2022.
- Perez GL, Vera MS, Miranda LA. Effects of Herbicide Glyphosate and Glyphosate-Based Formulations on Aquatic Ecosystems. Hlm, 2011, 343-368.
- Prasetyo H, Dan Zaman S. Pengendalian Gulma Perkebunan Kelapa Sawit (*Elaeis Guineensis* Jacq.) Di Perkebunan Padang Halaban, Sumatera Utara. Buletin Agrohorti, 2016;4(1):87-93.
- Pujiswanto H, Susanto H, Saputra RA. Efikasi Herbisida Amonium Glufosinat Untuk Pengendalian Gulma Pada Tanaman Kelapa Sawit (*Elaeis Guineensis* Jacq.) Menghasilkan. Jurnal Agrotek Tropika, Mei, 2022;10(2):301-30
- Purnomo WE, Dan Hasjim S. Efektivitas Dan Selektivitas Beberapa Bahan Aktif Herbisida Untuk Mengendalikan Gulma Pada Dua Varietas Tanaman Kacang Panjang (*Vigna sesquipedalis* L.). Jurnal Proteksi Tanaman Tropis, 2020, 1(2).
- Purwasih SD, Sarbino Rahmidiyani. Struktur Komunitas Gulma Pada Kebun Peremajaan Kelapa Sawit Di Lahan Gambut Pt. Bumi Pratama Khatulistiwa (Bpk). Jurnal Untan, 2013.
- Shintarika F. Inventarisasi Dominansi Gula Pada Pertanaman Jagung (*Zea Mays* L.) Fase Generatif Di Bapeltan Lampung. *Agrosainta: Widyaiswara Mandiri Membangun Bangsa*, 2021;6(1):49-54.
- Sianturin Teknik Pengendalian Opt. Balai Penelitian Surabaya, 2001.
- Singh AK, Singh A, SB Singh. Relative Efficacy of Herbicides for Weed Control in Rice: A Review. Int.J. Curr.Microbiol. App.Sci, 2020;9(2):2375-2382
- Takano Hk, Dayan Fe. Glufosinate Ammonium: A Review of The Current State of Knowledge. Pest Manag Sci, 2020;76:3911-3925.
- Tampubolon K, Purba E. Konfirmasi Resistensi *Eleusine Indica* Terhadap Glifosat Pada Perkebunan Kelapa Sawit Di Kabupaten Langkat. Jurnal Pertanian Tropik Issn No :2356- 4725, 2018;5(2)(34):276- 283.
- Tanasale V, Kilkoda A, Lahalimu Z. Diversity and Weed Dominance in Coconut Plantation Area at Different Crop Stadiums in Tial Village, Central Maluku District. Cropsaver: Journal of Plant Protection, 2024;7(1):1-9.
- Tolik M, Afrillah M, Dan Alfides H. Manajemen Pengendalian Gulma Tanaman Kelapa Sawit (*Elaeis Guineensis* Jacq.) Biofarm: Jurnal Ilmiah Pertanian, 2023;19(1):125-130.
- Tomlin CDS. Eleventh Edition. The Pesticide Manual. United Kingdom: British Crop Protection Council, 1997.
- Ugot H, Syahputra E, Dan Rahmidayani R. Keefektifan Herbisida Ipa Glifosat (480 G/L) Dalam Mengendalikan Gulma Pada Budidaya Kelapa Sawit Tbm. Perkebunan Dan Lahan Tropika, 2022;12(2):74-85.
- 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. J. Penelit. Kelapa Sawit, 2018;26(1):29-35.
- Umiyati U, Widayat D, Kurniadie D, Aris K. Respon Pertumbuhan Gulma Dan Hasil Tanaman Jagung

- Terhadap Herbisida 276 G/L Pada Sistem Tanam Tot. *Agrotechnology Research Journal*,2019:3(1):18-22.
24. Wahyudi D, Siregar IK, Agustiawan D. Pengelolaan Kebun Kelapa Sawit (*Elaeis Guineensis* Jacq.) Fase Tanaman Belum Menghasilkan Berbasis Instrumen Presisi Gps Android. *Jurnal Budidaya Perkebunan Kelapa Sawit Dan Karet. Agro Estate*, 2024, 8(2).
 25. Winarna Siregar HH, Dan Rahutomo S. *Pengelolaan Air Dan Hara Terpadu Untuk Optimalisasi Produksi Kelapa Sawit*. Ppks Press, 2022.