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Identification dominance and impact of Imperata cylindrica in oil palm plantations: a literature review

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ABSTRACT

Weeds are a major obstacle in oil palm cultivation, as their presence can disrupt plant growth through competition for nutrients, water, sunlight, and growing space. One of the most dominant weeds found in oil palm plantations is Imperata cylindrica. This study aims to identify the characteristics, level of dominance, and effects of Imperata cylindrica on oil palm plants. The method used in this study is a literature review, based on various national and international scientific journals related to Imperata cylindrica and oil palm plantations. The results show that Imperata cylindrica is an invasive weed from the Poaceae family with high adaptability, an extensive rhizome system, and rapid reproduction through seeds and rhizomes. Its presence causes intense competition for nutrients, water, and light, and it also produces allelopathic compounds that inhibit plant growth. The dominance of this weed is strongly influenced by open land conditions with high light intensity. In conclusion, Imperata cylindrica has a significant negative impact on the growth and productivity of oil palm plants. Therefore, integrated weed control methods, including mechanical, chemical, and cultural approaches, are necessary to maintain optimal plantation productivity.

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1. INTRODUCTION

Oil palm (Elaeis guineensis Jacq.) is one of the main plantation commodities in Indonesia, contributing significantly to the national economy through the production of crude palm oil (CPO). The area of oil palm plantations in Indonesia continues to increase year after year in line with the growing global demand for vegetable oil (Descals et al., 2021).

During the cultivation process, various factors can affect plant growth and productivity, one of which is the presence of weeds in plantation areas. Weeds are nuisance plants that grow in undesirable locations and compete with cultivated plants for nutrients, water, sunlight, and growing space. In addition to inhibiting the growth of the main crop, weeds also have the potential to host pests and plant diseases.

(Imaniasita et al., 2020) explain that the presence of weeds in cultivated land can cause significant competition, thus disrupting the growth of the main crop. In oil palm plantations,

poorly controlled weeds can reduce fertilizer efficiency and increase plantation maintenance costs (Ali et al., 2021). One type of weed commonly found in oil palm plantations is Imperata cylindrica (Imperata cylindrica). This weed is an invasive plant from the Poaceae family that is highly adaptable to various environmental conditions. Imperata cylindrica reproduces rapidly through seeds and rhizomes, making its spread difficult to control.

According to (Rusmarini et al., 2023) Imperata cylindrica generally dominates oil palm plantations, especially in mature crops, due to the open conditions of the area and high levels of sunlight. The presence of Imperata cylindrica negatively impacts oil palm growth. This weed can absorb large amounts of nutrients and water, reducing their availability to the main crop. Furthermore, Imperata cylindrica is known to produce allelopathic compounds that can inhibit the growth of surrounding plants.

(Kato-Noguchi, 2022) stated that Imperata cylindrica produces allelochemical compounds that can inhibit root development and the growth of cultivated plants. The dominance of Imperata cylindrica in plantation areas can also increase the risk of land fires because its dry biomass is flammable (Ali et al., 2021) Based on these conditions, identification of Imperata cylindrica weeds in oil palm plantations is necessary to determine their characteristics, level of dominance, and impact on oil palm growth. Therefore, this study aims to systematically review the characteristics, dominance, and ecological impacts of *Imperata cylindrica* in oil palm plantations, in order to provide a clearer scientific basis for developing more effective and sustainable weed management strategies.

2. METHOD

This research employed a literature review method, utilizing various scientific sources related to the weed Imperata cylindrica in oil palm plantations. Reference sources included national and international journals, scientific articles, and proceedings relevant to the research topic. The literature review method was chosen because it provides extensive information on the characteristics, dominance levels, and effects of Imperata cylindrica on oil palm growth. The research process was carried out in stages, including reference collection, identification of important information, data analysis, and compilation of the results. Data collection was conducted through a search of various scientific publications discussing weed vegetation, Imperata cylindrica allelopathy, weed dominance in oil palm plantations, and the impact of weeds on cultivated plants.

The obtained references were then selected based on their relevance to the research topic and publication year to ensure the data used remained relevant and supported the research. Data analysis was conducted descriptively by comparing the results of several previous studies. The information analyzed includes the morphological characteristics of Imperata Cylindrica, weed reproductive capacity, dominance levels in oil palm plantations, and their impact on plant growth. Furthermore, this study also examines several weed control methods commonly applied in oil palm plantations. Weed observations were conducted based on field documentation obtained in the oil palm plantation area of the Indonesian Palm Oil Technology Institute. This documentation was used to support the morphological identification of Imperata cylindrica weeds and to observe the condition of weed dominance in the plantation area.

3. RESULTS AND DISCUSSION

3.1 Characteristics of the Imperata Cylindrica

Weed Imperata cylindrica is a type of weed that has a high level of dominance in various ecosystems, particularly in oil palm plantations with open land conditions. This weed belongs to the Poaceae family and is classified as a perennial plant capable of long-term survival. Its ability to adapt to various environmental conditions makes Imperata cylindrica often found in agricultural land, abandoned land, and even degraded land with low fertility levels. Furthermore, this weed can grow well in high light intensity conditions, making it more common in young or immature oil palm plantations, where the plant canopy has not yet optimally covered the soil surface (Satriawan & Fuady, 2019). This high adaptability is supported by Imperata cylindrica's highly efficient reproductive system. This weed can reproduce generatively through seeds, which are abundant and easily dispersed by the wind. Furthermore, vegetative reproduction through rhizomes is a major factor that makes this weed difficult to control in the field. Rhizomes, which grow underground, can spread widely and produce new shoots quickly, even from small pieces of plant tissue. This condition gives this weed a very high regeneration capacity after control, often resulting in it re-emerging and dominating the field in a relatively short time (S. Hidayat et al., 2018).

Figure 1. Rhizome system of the Imperata cylindrica weed on an oil palm plantation

Morphologically, Imperata cylindrica is characterized by narrow, elongated (linear) leaves with pointed tips and a rough leaf surface. This leaf structure allows the plant to maintain efficient photosynthesis in high light conditions. This plant can grow to varying heights, ranging from around 30 cm to over 2 meters, depending on environmental conditions such as water and nutrient availability. In addition, the extensive root and rhizome systems in the soil enable this weed to absorb large amounts of water and nutrients, thereby increasing its competitiveness against the main plants around it (Ramadhani et al., 2026). In addition to its morphological and reproductive characteristics, Imperata cylindrica also exhibits a highly competitive ability against other plants. This weed is capable of forming dense populations and covering the soil surface, thus inhibiting the growth of other plants in the surrounding area. This ability is related to the efficient use of environmental resources such as light, water, and nutrients. Under certain conditions, the dominance of this weed can lead to a decrease in the diversity of other plants in an area because other species are unable to compete with its aggressive growth (Munadi et al., 2023).

Figure 2. Dominance of Imperata cylindrica weeds in oil palm plantations.

Overall, the characteristics of Imperata cylindrica, including its broad adaptability, rapid reproductive system, favorable morphological structure, and high competitiveness, make this weed one of the most difficult invasive weeds to control in oil palm plantations. The combination of these characteristics allows this weed to grow rapidly and dominate the land in a relatively short time, especially in favorable environmental conditions such as open areas with high light intensity (Mutsaers, 2019).

Table 1. Morphological characteristics of the weed Imperata Cylindrica

No	Characteristics	Information
1	Family	Poaceae
2	Weed type	Perennial weeds
3	Method of reproduction	Seeds dan rhizoma
4	Leaf shape	Linear and tapered
5	Habitat	Open land and plantations

The data in Table 1 shows that Imperata cylindrica has a high adaptability to various environmental conditions. This characteristic is one of the factors that has enabled Imperata cylindrica to dominate oil palm plantations in a relatively short time.

Table 2. Research results on the dominance of Imperata Cylindrica weeds

Researcher	Research Location	Research Result
(Imaniasita et al., 2020)	Soybean land under oil palm	Imperata Cylindrica is a dominant weed from the poaceae family
(Rusmarini et al., 2023)	TBM and TM oil palm plantations	The open land dominating of Alang-alang in TBM gardens
(Satriawan & Fuady, 2019)	Aceh oil palm plantations	Weed vegetation is influenced by plant age and light intensity

To strengthen the analysis, a comparative synthesis of previous studies is presented in Table 3

Table 3. Comparative Analysis of Imperata cylindrica Studies

Author	Focus	Key Findings	Implication
Imaniasita et al. (2020)	Weed dominance	Dominant in cultivated land	Strong competition
Rusmarini et al. (2023)	Vegetation	Dominates open areas	Light affects growth
Satriawan & Fuady (2019)	Ecology	Influenced by plant age	Early stage vulnerable
Kato-Noguchi (2022)	Allelopathy	Produces allelochemicals	Growth inhibition
Ali et al. (2021)	Impact	Cost & fire risk increase	Management challenge

Based on the results of several studies, it can be seen that Imperata cylindrica is a dominant weed in various cultivated areas, particularly in oil palm plantations with open areas. Its high adaptability and reproductive capacity allow Imperata cylindrica to grow more rapidly than other weeds.

Based on the reviewed literature, research on Imperata cylindrica has evolved over time. Earlier studies mainly focused on weed identification and vegetation analysis, whereas more recent studies emphasize ecological interactions, allelopathy, and the influence of environmental changes on weed distribution (Jung & Shin, 2021; Rad et al., 2025). This indicates a shift from descriptive to more analytical and ecological research approache s vb.

3.2 Impact of Weeds on Oil Palm Growth

The presence of Imperata cylindrica in oil palm plantations negatively impacts the growth of the main crop. Imperata cylindrica weeds compete for nutrients, water, sunlight, and growing space, thus inhibiting vegetative growth of the oil palm plants. According to (Imaniasita et al., 2020) the presence of weeds in cultivated areas can cause intense competition with the main crop, disrupting plant growth.

Continued competition can lead to reduced growth of oil palm plants, especially in the immature phase. In addition to competing for nutrients and water, Imperata cylindrica is also known to produce allelopathic compounds that can inhibit the growth of surrounding plants.

Kato-Noguchi, 2022 explains that Imperata cylindrica produces allelochemical compounds that can inhibit root development and growth of cultivated plants. These allelopathic compounds are released through the roots, rhizomes, and through the decomposition of plant tissue. The presence of these compounds causes oil palm plants to experience growth disorders if the population of alang-alang weeds is too high in the plantation area. The allelopathic effect of Imperata cylindrica occurs through the release of allelochemicals from roots, rhizomes, and decomposed plant residues. These compounds interfere with physiological processes such as root elongation, nutrient uptake, and cell division. As a result, oil palm plants experience growth inhibition, particularly during early developmental stages (Kato-Noguchi, 2022).

Table 4. Impact of Imperata Cylindrica weeds on Oil Palm Plants

No	Weed Impact	Influence on Plants
1	Competition for nutrients	Inhibit plant growth
2	Water competition	Reduces water absorption
3	Light competition	Inhibit the process of photosythesis
4	Allelopathy	Inhibit root development
5	Fire risk	Increasing land damage
6	Weed dominance	Reduces maintenance effciency

The data in Table 4 shows that the presence of Imperata cylindrica has various negative impacts on the growth and productivity of oil palm plantations. In addition to inhibiting plant growth, weed dominance can also increase plantation maintenance costs, as routine control is required to maintain optimal plant growth. (Ali et al., 2021) stated that weeds in oil palm plantations can hamper plantation management and increase the risk of land fires due to the flammability of dry biomass. Imperata cylindrica weed control requires an integrated approach using mechanical, chemical, and cultural methods. Mechanical control involves clearing and removing rhizomes, while chemical control utilizes systematic herbicides to suppress weed growth.

Furthermore, the use of ground cover crops can also help reduce the dominance of Imperata cylindrica in oil palm plantations. A combination of these control methods is expected to suppress weed growth more effectively and sustainably. The data in Table 3 shows that the presence of Imperata cylindrica has various negative impacts on the growth and productivity of oil palm plantations. In addition to inhibiting plant growth,

weed dominance can also increase plantation maintenance costs, as routine control is required to maintain optimal plant growth.

In addition to resource competition, prolonged weed presence can reduce plant height, biomass accumulation, and overall vigor of oil palm plants. These effects are more pronounced in immature plantations, where competition for light and nutrients is more intense (Imaniasita et al., 2020).

Ali et al., 2021 stated that weeds in oil palm plantations can hamper plantation management and increase the risk of land fires due to the flammability of dry biomass. Imperata cylindrica weed control requires an integrated approach using mechanical, chemical, and cultural methods. Mechanical control involves clearing and removing rhizomes, while chemical control utilizes systematic herbicides to suppress weed growth. Furthermore, the use of ground cover crops can also help reduce the dominance of Imperata cylindrica in oil palm plantations. A combination of these control methods is expected to suppress weed growth more effectively and sustainably. From an agronomic perspective, the dominance of Imperata cylindrica reduces fertilizer efficiency, increases maintenance costs, and complicates plantation management. The accumulation of dry biomass also increases the risk of fire, particularly in unmanaged plantation areas (Ali et al., 2021).

3.3 Impact of Weeds on Oil Palm Growth

The dominance of the weed Imperata cylindrica in oil palm plantations is a major problem that can hinder the growth of the main crop. This weed is known as an invasive species with a high adaptability to various environmental conditions and the ability to grow rapidly in open areas. In oil palm plantations, especially during the immature phase, open land conditions and high levels of sunlight are the main factors supporting the growth of this weed. As a result, Imperata cylindrica is able to grow faster than other vegetation and gradually dominate the available growing space (P. Hidayat et al., 2023) This dominance is closely related to the highly aggressive biological characteristics of Imperata cylindrica, particularly through its extensive underground rhizome system. These rhizomes serve as the primary means of vegetative reproduction, enabling the plant to produce large numbers of new individuals and rapidly expand its growing area. Furthermore, rhizomes remaining in the soil after the control process are still able to regrow, making this weed difficult to completely eradicate. This indicates that vegetative reproduction through rhizomes is a major factor supporting the sustainability and dominance of this weed in the field (Rad et al., 2025).

In addition to its reproductive system, this weed's dominance is also influenced by its ability to utilize environmental resources more efficiently than other plants. Imperata cylindrica has a strong root system that allows it to absorb large amounts of water and nutrients, ultimately reducing the availability of resources for oil palm plants. When in high populations, this weed can form dense vegetation and cover the soil surface, inhibiting the growth of other plants through competition for space and light. This condition indicates a high level of weed competition in an agroecosystem (Dwimartina & Asad, 2025).

Environmental factors are also key determinants of the dominance of Imperata cylindrica. High sunlight intensity, open land conditions, and minimal shade are conditions that strongly support the growth of this weed. Furthermore, environmental changes such as increasing temperatures and varying climate conditions also play a role in expanding the spread of this weed across various regions. This suggests that environmental factors not only influence growth but also determine the dominance of Imperata cylindrica within an ecosystem (Rad et al., 2025). Furthermore, Imperata cylindrica is also known as a pioneer weed, exhibiting high resilience to various environmental conditions, including the ability to survive in less fertile soils. This weed is able to maintain its presence despite disturbances such as weeding or chemical control, often reappearing and dominating the field within a relatively short time. When present in high populations, the presence of this weed can also exacerbate land conditions by potentially increasing the risk of other disturbances in plantations, such as a decline in the quality of the growing environment for primary crops (Studi Agroteknologi & Pertanian INSTIPER Yogyakarta, 2023).

Overall, the dominance of Imperata cylindrica in oil palm plantations is influenced by a combination of plant biology and environmental conditions. Its high adaptability, efficient rhizome reproduction, and strong competitiveness enable this weed to grow rapidly and dominate land in a relatively short time. Furthermore, the weed's success in maintaining its population also demonstrates a complex interaction between internal plant factors and supportive environmental conditions, making it a dominant weed that is difficult to control in various agricultural ecosystems (Jung & Shin, 2021).

Various weed control strategies have been applied to manage Imperata cylindrica. Mechanical control is effective for short-term removal but requires high labor input. Chemical control provides faster results but may pose environmental risks if used excessively. Cultural methods, such as the use of cover crops, can suppress weed growth sustainably. Therefore, an integrated weed management approach is considered the most effective strategy for long-term control.

4. CONCLUSION

Based on the results of this study, Imperata cylindrica is identified as an invasive weed with high adaptability, rapid reproduction through seeds and rhizomes, and strong competitiveness in oil palm plantations. Its presence negatively affects oil palm growth through competition for nutrients, water, sunlight, and space, as well as through the production of allelopathic compounds that inhibit plant development. Therefore, integrated weed management strategies, including mechanical, chemical, and cultural methods, are essential to maintain plantation productivity. Further research is recommended to explore more effective and environmentally friendly weed control strategies, particularly through the development of biological control methods and sustainable land management practices. In addition, future studies should focus on quantifying the impact of Imperata cylindrica on oil palm yield and productivity under different environmental conditions. Research on the long-term effectiveness of integrated weed management and the role of climate change in influencing weed distribution and dominance is also necessary to support sustainable oil palm cultivation.

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REFERENCES

Ali, N. B. M., Karim, M. F. A., Saharizan, N., Adnan, N. S., Mazri, N. H., Fikri, N. A., Amaludin, N. A., & Zakaria, R. (2021). Weeds diversity in oil palm plantation at Segamat, Johor. *IOP Conference Series: Earth and Environmental Science*, *756*(1). https://doi.org/10.1088/1755-1315/756/1/012034

Descals, A., Wich, S., Meijaard, E., Gaveau, D. L. A., Peedell, S., & Szantoi, Z. (2021). High-resolution global map of smallholder and industrial closed-canopy oil palm plantations. *Earth System Science Data*, *13*(3), 1211–1231. https://doi.org/10.5194/essd-13-1211-2021

Dwimartina, F., & Asad, F. Al. (2025). Identifikasi Keanekaragaman dan Dominansi Gulma Pada Lahan Pertanaman Mangga Gedong Gincu di Desa Lohbener Indramayu. *Agro Wiralodra*, *8*(1), 12–17. https://doi.org/10.31943/agrowiralodra.v8i1.138

Hidayat, P., Putri, A. W., Evizal, R., & Sriyani, N. (2023). Efikasi Herbisida Parakuat terhadap Gulma pada Kebun Kelapa Sawit (Elaeis guineensis Jack.) Belum Menghasilkan (TBM). *Jurnal Agrotropika*, *22*(2), 91. https://doi.org/10.23960/ja.v22i2.7686

Hidayat, S., Abu Bakar, M. S., Yang, Y., Phusunti, N., & Bridgwater, A. V. (2018). Characterisation and Py-GC/MS analysis of Imperata Cylindrica as potential biomass for bio-oil production in Brunei Darussalam. *Journal of Analytical and Applied Pyrolysis*, *134*, 510–519. https://doi.org/10.1016/j.jaap.2018.07.018

Imaniasita, V., Liana, T., & Pamungkas, D. S. (2020). Identifikasi Keragaman dan Dominansi Gulma pada Lahan Pertanaman Kedelai. *Agrotechnology Research Journal*, *4*(1), 11–16. https://doi.org/10.20961/agrotechresj.v4i1.36449

Jung, Y. K., & Shin, D. (2021). Imperata cylindrica: A review of phytochemistry, pharmacology, and industrial applications. *Molecules*, *26*(5). https://doi.org/10.3390/molecules26051454

Kato-Noguchi, H. (2022). Allelopathy and Allelochemicals of Imperata cylindrica as an Invasive Plant Species. *Plants*, *11*(19), 11–14. https://doi.org/10.3390/plants11192551

Munadi, L. O. M., Pagala, M. A., Nafiu, L. O., & Zulkarnain, D. (2023). Oil Palm Plantation and Plant Species Diversity in Kolaka District, Indonesia. *WSEAS Transactions on Systems*, *22*, 249–254. https://doi.org/10.37394/23202.2023.22.26

Mutsaers, H. J. W. (2019). The challenge of the oil palm: Using degraded land for its cultivation. *Outlook on Agriculture*, *48*(3), 190–197. https://doi.org/10.1177/0030727019858720

Rad, S. P. H., Duque, T. S., Flory, S. L., do Nascimento, V. G., Mendes, D. S., Maciel, J. C., dos Santos, J. B., da Silva, R. S., & Shabani, F. (2025). Predicting the spread of invasive Imperata cylindrica under climate change: A global risk assessment and future distribution scenarios. *PLoS ONE*, *20*(5 May), 1–12. https://doi.org/10.1371/journal.pone.0321027

Ramadhani, P., Sianturi, R., Lesmana, R. D., & Sinaga, I. (2026). *Respon Fisiologis Kelapa Sawit terhadap Kompetisi Gulma Imperata Cylindrica*. *10*, 8778–8782.

Rusmarini, U. K., Astuti, Y. T. M., & Parulian, D. (2023). Vegetasi Gulma pada Lahan yang didominasi Alang-alang (Imperata cylindrica) di Kebun Kelapa Sawit Belum Menghasilkan dan Kebun Kelapa Sawit Menghasilkan. *Jurnal Pertanian Agros*, *25*(1), 385–395. https://e-journal.janabadra.ac.id/index.php/JA/article/view/2411

Satriawan, H., & Fuady, Z. (2019). Short communication: Analysis of weed vegetation in immature and mature oil palm plantations. *Biodiversitas*, *20*(11), 3292–3298. https://doi.org/10.13057/biodiv/d201123

Studi Agroteknologi, P., & Pertanian INSTIPER Yogyakarta, F. (2023). *Raihan Luthfan Sinaga*, Abdul Mu'in, Hangger Gahara Mawandha*. *1*(Nugroho 2019), 2169–2173..

Wibowo, C. S., et al. (2023). Genetic variants associated with leaf spot disease resistance in oil palm. *Plant Pathology*, 72, 1626–1636. https://doi.org/10.1111/ppa.13774

Zhang, D. *et al.* (2019) 'Virulence , Molecular Diversity , and Mating Type of *Curvularia lunata* in China', 103(2017018), pp. 1728–1737. Available at: https://doi.org/10.1094/PDIS-10-18-1857-RE.