

STUDY OF THE COST OF FIREWORMS CONTROLLING USING THE FOGGING METHOD IN OIL PALM (*Elaeis guineensis* Jacq) PLANTATIONS AT PT. PERKEBUNAN NUSANTARA VI REGIONAL 1 KEBUN BANGUN

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Abstract

The attack of fireworms (*Setothosea asigna*) can reduce the production of fresh fruit bunches by 40–60%, so an effective, cost-effective control method is needed. This study aims to evaluate the cost of fireworm pest control using the fogging method on oil palm plantations at PT Perkebunan Nusantara IV Regional 1 Kebun Bangun. The study used a descriptive method, collecting primary field data and secondary data from the 2024 RKAP and department management reports. The fogging process included an attack census, solution preparation, and nighttime fogging. The results showed that the total area of fireworm pest attacks reached 139 hectares across 17 blocks. The peak of the attack occurred in March (60 hectares) and decreased through July (20 hectares), indicating the effectiveness of the fogging method in controlling fireworms. Overall, the total control cost amounted to IDR 40,195,772, or IDR 289,178/ha. The average cost of fogging materials was Rp118,335/ha, fuel Rp10,000/ha, and labor Rp27,750/ha. The largest cost component came from equipment (46.02%), followed by materials (44.38%) and labor (9.60%). Thus, the fogging method has proven effective in suppressing fireworm attacks and provides a cost overview that can be used as a basis for decision-making in pest management on oil palm plantations.

Keywords: Fogging, fireworms, Kebun Bangun, Decis 25 EC.

INTRODUCTION

Oil palm is an important plantation crop that produces edible oil, industrial oil, and biodiesel. As one of Indonesia's largest agricultural export commodities, oil palm plays a crucial role as a significant source of foreign exchange and tax revenue, contributing to economic and social growth. By 2023, oil palm plantations in Indonesia were managed in three types: Large Private Companies (PBS) at 51.17% (8,614,259 hectares); Smallholder Plantations (PR) at 40.02% (6,736,516 hectares); and Large State Plantations (PBN) at 3.43% (577,937 hectares). Of these three types of plantations, PBS and PR are the largest, totaling 13,711,594 hectares, or approximately 95.71% of Indonesia's total oil palm area (Kementerian Perkebunan, 2024). Oil palm is one of Indonesia's leading commodities, playing a vital role in the national economy, particularly as the world's largest source of vegetable oil. This crop has become widely known and intensively cultivated since the mid-20th century, in line with the increasing global demand for palm oil. Palm oil development is also supported by Indonesia's suitable tropical climate and vast land potential (Siradjuddin, 2015).

Indonesia is the world's largest palm oil producer. Demand for palm oil fruit is increasing sharply in line with the growing global demand for crude palm oil (CPO). Therefore, opportunities for oil palm plantations and the palm oil processing industry (PKS) remain highly promising, meeting both domestic and international markets. Generally, oil palms live for 20-25 years. During the first 1-3 years, oil palms are referred to as Immature Plants (TBM). During the TBM period, farmers cannot yet generate income, and oil palms must be maintained and cared for to achieve optimal productivity. Pests and diseases are important factors to consider in oil palm cultivation. Pest attacks on oil palms can have significant negative impacts, such as reduced production and even plant death. Pests and diseases can attack oil palm plants from the nursery stage through the mature plant (TM) stage. Based on observations conducted by researchers at PT. Perkebunan Nusantara (PTPN) IV Regional 1 Kebun Bangun discovered numerous infestations of the fireworm (*Setothosea asigna*), which attacks oil palms at the mature plant stage (18 years old). The fireworm is a leaf-eating caterpillar that frequently causes losses in oil palm plantations. This pest is characterized by its coarse, stiff, and poisonous back, which gives it the name fireworm. The liquid poison released from these coarse hairs can cause itching and burning if it comes into contact with the hands (Elvira,

2021). In a single oil palm plant, the fireworm population can reach 5-10 individuals, with each individual capable of consuming 300-500 cm² of oil palm leaves (Munir & Wiraguna, 2025). Fireworm infestations on oil palm plantations can cause leaf damage, defoliation, and a 40-60% reduction in fresh fruit bunch (FFB) production. These pests feed on leaves from the base to the young leaves, disrupting photosynthesis and ultimately reducing oil palm production (Mariana et al., 2023). Pest control is a crucial part of crop management, aiming to effectively and sustainably reduce losses from attacks by Plant Pest Organisms (PPOs). This approach integrates biological, cultural, and chemical methods, such as natural enemies and botanical pesticides, to maintain ecosystem balance and increase crop productivity (Indiati & Marwoto, 2017).

Fogging is a pest control method used to reduce pest populations, including fireworms, rapidly. Mariana et al. (2023) reported that fogging reduced fireworm infestations by up to 87.8% in the Matapao Plantation Unit of PT. Socfindo, from 4.7-10.4 per leaf frond to 0.7-1 per leaf frond. In another study, Krisna et al. (2023) reported that fogging at PT Supra Matra Abadi with 30% deltamethrin was effective in significantly reducing fireworm populations, suitable for night use, and more environmentally friendly than conventional spraying. One factor to consider in fogging implementation is cost. The cost of fogging implementation includes the cost of materials, equipment, and fogging implementers. Therefore, it is very important to assess the cost of fogging in order to control fireworm pests in oil palm plantations. Existing studies still focus on the effectiveness of the fogging method for controlling fireworm pests in oil palm plantations, but have not evaluated the associated costs. Based on this background, this study was conducted to evaluate the cost requirements for fogging activities at PTPN IV Regional 1 Kebun Bunga, North Sumatra Province. This study is expected to provide an overview of fogging's feasibility as a method for controlling fireworm pests under field conditions, which can later serve as a basis for decision-making for fireworm pest management at PTPN IV Regional 1 Kebun Bunga.

METHOD

This research was conducted at PTPN IV Regional 1 Kebun Bangun in August 2025. The method used was descriptive analysis, which involved collecting and retrieval of data at the research site. Secondary data were collected from the 2024 Company Work Plan and Budget (RKAP) and the June 2024 Afdeling Management Report. The fogging process began with a census to identify blocks infested with fire caterpillars, followed by preparing the fogging solution and fogging. The level of fire caterpillar infestation was categorized as light (5 caterpillars/leaf frond), moderate (10 caterpillars/leaf frond), and severe (>10 caterpillars/leaf frond).

RESULTS AND DISCUSSION

Overview of Kebun Bangun

Initially, Kebun Bangun was a plantation owned by a Dutch company that was nationalized in 1958. Briefly, the history of Kebun Bangun's establishment is as follows:

- 1958 to 1961: New VAT
- 1961 to 1963: North Sumatra III
- 1963 to 1969: Rubber VAT VI
- 1970 to 1976: PNP IV
- 1976 to 1994: PTP IV

In May 1995, PTP IV merged with PTP III, IV, and V to improve management and increase company efficiency. Effective March 4, 1996, it officially became PT. Perkebunan Nusantara IV, headquartered at Jalan Sei Batang Hari No. 2, Medan, in accordance with Government Regulation No. Based on Decree No. 8/1996 dated February 14, 1996, Kebun Bangun became one of its plantation units. Kebun Bangun is located in the Bangun Rayon (Gunung Malela District) at an altitude of 237 meters above sea level and in the Simbolon Rayon (Panombeian Panei District and Pematang Siantar Municipality) at an altitude of 400 meters above sea level, with coordinates 99°10'5" East Longitude, 02°58'28" North Latitude. Kebun Bangun is approximately 123 km from the center of Medan City, approximately 48 km from the center of Tebing Tinggi City, and approximately 12 km from the center of Pematang Siantar City. The soil structure in Kebun Bangun consists of yellowish-red podzolic soil (sandy clay texture, good drainage; S2 class of moderate suitability), with an effective soil depth of >100 cm.

Rainfall Data

Rainfall data at PT. Perkebunan Nusantara IV Regional 1 Kebun Bangun is shown in Figure 1. Rainfall distribution shows significant annual fluctuations in both the number of rainy days (HH) and total rainfall (mm). 2020 and 2021 were the periods with the highest rainfall (>4,000 mm/year), while 2023 and 2024 showed a

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significant downward trend (<3,000 mm/year). Monthly rainfall generally occurs in October and November, while relatively dry periods occur in February, March, and July. These fluctuations indicate a humid tropical climate pattern with seasonal variations in intensity that can influence pest population dynamics in oil palm plantations.

PTP. NUSANTARA - III KEBUN : BANGUN		DATA CURAH HUJAN												RAYON : BANGUN	
BULAN	2019		2020		2021		2022		2023		2024		2025		
	HH	MM	HH	MM	HH	MM	HH	MM	HH	MM	HH	MM	HH	MM	
JANUARI	10	288	2	71	13	373	8	191	14	331	12	143	18	228	
FEBRUARI	3	60	6	159	2	44	13	312	11	212	8	67	12	175	
MARET	6	126	8	134	11	252	11	332	9	153	11	103	16	179	
APRIL	11	197	11	284	12	264	11	189	9	162	7	121	16	281	
MEI	14	311	16	485	15	345	15	352	10	124	9	110	16	252	
JUNI	13	252	13	511	15	387	17	431	10	155	9	128	12	183	
JULI	7	162	16	481	11	363	9	177	12	163	8	136	7	98	
AGUSTUS	8	202	12	273	19	699	14	275	22	358	13	320	16	220	
SEPTEMBER	10	247	17	541	15	391	15	383	15	314	17	377			
OKTOBER	18	486	16	389	17	449	22	437	21	321	17	345			
NOPEMBER	19	503	19	653	23	682	23	450	16	300	16	308			
DESEMBER	10	211	15	524	4	89	20	363	15	218	18	215			
JUMLAH	129	3.045	151	4.505	157	4.338	178	3.892	164	2.811	145	2.373	113	1.616	

Figure 1. Rainfall data at PT. Perkebunan Nusantara IV Regional 1 Kebun Bangun

Fireworms Controlling

Fireworm pest control was carried out using Decis 25 EC insecticide, a spreader-emulsifier, and High Speed Diesel (HSD) as the diesel fuel. The fogging material was prepared by mixing water with the emulsifier and stirring for 20 minutes. Next, Percis insecticide was added to the mixture and stirred for another 20 minutes. Finally, diesel fuel was added to the mixture and stirred again for another 20 minutes. The fogging process was carried out in the middle of the night. Decis 25 EC is an insecticide containing the active ingredient deltamethrin (C₁₂H₁₉Br₂NO₃) or [(S)-cyano-(3-phenoxyphenyl)methyl] (1R,3R)-3-(2,2-dibromoethenyl)-2,2-dimethylcyclopropane-1-carboxylate. The dosage used was 250 cc/ha, mixed with 700 cc/ha of water, in accordance with the Standard Operating Procedure (SOP) at PTPN IV—Decis 25 EC. It works by penetrating harmful insects through the stomach, respiratory tract, or contact. After penetrating nerve cells, this pesticide inhibits acetylcholinesterase (AChE), causing death within a short time after application (Sikorski & Beś, 2022). The Decis 25 EC dosage used was 250 cc/ha, mixed with 700 cc/ha of water, in accordance with the Standard Operating Procedure (SOP) at PTPN IV.

An emulsifier is a pesticide adjuvant that functions as a mixer and stabilizer for the solution between the main insecticide ingredient and water. The emulsifier is a concentrated liquid that is easily mixed into the fogging solution. The use of an emulsifier ensures the Decis 25 EC mixture blends perfectly, prevents separation, and produces an even spray mist during fogging. The emulsifier dosage used was 50 cc/ha, in accordance with the SOP at PTPN IV. The emulsifier is mixed with the main ingredient in Decis 25 EC to ensure more effective, efficient pest control. Diesel fuel functions as high-speed diesel (HSD) during fogging to maximize smoke production (dense white smoke). The required diesel fuel dosage is 1,500 cc/ha, according to PTPN IV's standard operating procedure.

The Cost of Controlling the Fireworms

Details of the material cost components are summarized in Tables 1 and 2. The spike in the severity of fireworm pest attacks occurred in March, with a total of 60 hectares, and ended in July, with a total of 20 hectares. This indicates that fireworm pest control using the fogging method was effective with a total material cost of Rp118,335/hectare and the cost of fogging machine fuel of Rp10,000/hectare.

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Tabel 1. Material costs

Month	Block	Widespread Area (Ha)	Materials									
			Decis 25 EC			Emulgator			Diesel fuel			
			Dose per Ha (mL)	Cost per Liter (Rp)	Sum. (Rp)	Dose per Ha (mL)	Cost per Liter (Rp)	Sum. (Rp)	Dose per Ha (mL)	Cost per Liter (Rp)	Sum. (Rp)	
Jan	-	-	-	-	-	-	-	-	-	-	-	-
Feb	B07, D03, E04, F04	29	250	262,732	1,904,807	50	230,375	333,043	1,500	27,374	1,190,769	
Mar	B07, B08, C03, D03, D04, E04, F04, E05, F05	60	250	262,732	3,940,980	50	230,375	691,125	1,500	27,374	2,463,660	
Apr	-	-	-	-	-	-	-	-	-	-	-	-
May	-	-	-	-	-	-	-	-	-	-	-	-
Jun	D03, F04	30	250	262,732	1,313,660	50	230,375	230,375	1,500	27,374	821,220	
Jul	F07, F07b	20	250	262,732	1,970,490	50	230,375	345,562	1,500	27,374	1,231,830	
Aug	-	-	-	-	-	-	-	-	-	-	-	-
Sep	-	-	-	-	-	-	-	-	-	-	-	-
Oct	-	-	-	-	-	-	-	-	-	-	-	-
Nov	-	-	-	-	-	-	-	-	-	-	-	-
Dec	-	-	-	-	-	-	-	-	-	-	-	-
Total	17 Blocks	139			9,139,937			1,601,106			5.707.479	
Total material cost for fogging										16,448,522.		
Average material cost for fogging per hectare										118,335		

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Table 2. Fuel costs

Month	Block	Widespread Attack (Ha)	Fogging Machine Fuel (Pertalite)		
			Dose (L)	Cost per Liter (Rp)	Fuel Cost (Rp/Ha)
Jan	-	-	-	-	-
Feb	B07, D03, E04, F04	29	1	10,000	290,000
Mar	B07, B08, C03, D03, D04, E04, F04, E05, F05	60	1	10,000	600,000
Apr	-	-	-	-	-
May	-	-	-	-	-
Jun	D03, F04	30	1	10,000	300,000
Jul	F07, F07b	20	1	10,000	200,000
Aug	-	-	-	-	-
Sep	-	-	-	-	-
Oct	-	-	-	-	-
Nov	-	-	-	-	-
Dec	-	-	-	-	-
Total	17 Blocks	139			1,390,000
Average fuel cost per hectare				Rp. 10,000	

PTPN IV Regional 1 Kebun Bangun has a fogging labor cost of Rp. 55,500 per hectare. Therefore, the total labor costs required in 2025 are shown in Table 3.

Table 3. Labor costs

Month	Block	Widespread Attack (Ha)	Working Day/Ha	Rates (Rp)	Working Day Requirement	Sum. (Rp)
Jan	-	-	-	-	-	-
Feb	B07, D03, E04, F04	29	0.5	55,500	14.5 HK	804,750
Mar	B07, B08, C03, D03, D04, E04, F04, E05, F05	60	0.5	55,500	30 HK	1,665,000
Apr	-	-	-	-	-	-
May	-	-	-	-	-	-
Jun	D03, F04	30	0.5	55,500	10 HK	555,000
Jul	F07, F07b	20	0.5	55,500	15 HK	832,500
Aug	-	-	-	-	-	-
Sep	-	-	-	-	-	-
Oct	-	-	-	-	-	-
Nov	-	-	-	-	-	-
Dec	-	-	-	-	-	-
Total	17 Blocks	139 Ha			69.5 HK	3,857,250

Fogging activities require fogging equipment and Personal Protective Equipment (PPE). At PTPN IV Regional 1 Kebun Bangun, PPE is provided by the plantation unit and does not come from departmental activities. Therefore, only fogging equipment is included in equipment costs. Details of equipment costs are summarized in Table 4.

Tabel 4. Equipment cost

No.	Tools	Number of Tools (Unit)	Cost (Rp)	Total Cost (Rp)	Shelf Life (Year)	Depreciation per Year (Rp)
1	Jerrycan	10	50,000	500,000	1	500,000
2	Fogging machine	2	45,000,000	90,000,000	5	18,000,000
Sum.				90,500,000		18,500,000
Total depreciation per year (Rp)					1,541,667	

A summary of costs for fireworm control activities is presented in Table 5. The total cost is Rp 40,195,772, or approximately Rp 289,178/hectare. Equipment is the largest component (46.02%), followed by material costs (44.38%) and labor (9.60%).

Tabel 5. Recapitulation of the costs of controlling fireworm pests using the fogging method

Cost Component	Area (Ha)	Total (Rp)
Material		17,838,522
Labor	139	3,857,250
Equipment		18,500,000
Total		40,195,772

CONCLUSION

Based on the research conducted, the total cost of controlling fireworms using the fogging method at PT. Perkebunan Nusantara IV Regional 1 Kebun Bangun in 2025 was Rp 40,195,772 or Rp 289,178/hectare. Equipment was the largest component (46.02%), followed by material costs (44.38%) and labor (9.60%).

REFERENCES

- Elvira, D. (2021). *Klasifikasi Citra Daun Kelapa Sawit yang Terkena Dampak Hama Menggunakan Metode K-Nearest Neighbor (KNN)* [Skripsi]. Universitas Islam Riau.
- Indiati, S. W., & Marwoto. (2017). Penerapan Pengendalian Hama Terpadu (PHT) pada Tanaman Kedelai. *Bulletin Palawija*, 15(2), 87–100.
- Kementerian Perkebunan. (2024). *Statistik perkebunan 2023-2025*.
- Krisna, J., Rizal, K., Sepriani, Y., & Saragih, S. H. Y. (2023). Pengendalian Hama Ulat Api (*Setothosea asigna*) secara Kimia pada Tanaman Kelapa Sawit (*Elaeis guineensis* Jacq) Menggunakan Fogging di PT Supra Matra Abadi (SMA) Kebun Aek Nabara. *Jurnal Pertanian Agros*, 25(1), 1093–1100.
- Mariana, M., Puspitaningrum, A., & Manullang, W. (2023). Keefektifan Pengendalian Hama Ulat Menggunakan Fogging pada Tanaman Kelapa Sawit di PT. Socfindo Kebun Matapao. *Jurnal Agrica EKstensia*, 17, 9–16.
- Munir, A., & Wiraguna, E. (2025). Pengaruh Ketinggian Tanaman Terhadap Keberhasilan Fogging dalam Mengendalikan Ulat Api (*Setothosea Asigna*) di PT Socfindo Kebun Matapao. *Botani: Publikasi Ilmu Tanaman Dan Agribisnis*, 2(2), 71–76. <https://doi.org/10.62951/botani.v2i2.315>
- Sikorski, Ł., & Beś, A. (2022). Behavioral Response in Toxicity Assessment of the Insecticide Decis® 2.5 EC toward Freshwater Zooplankton. *Water*, 14(2059), 1–10. <https://doi.org/10.3390/w14132059>
- Siradjuddin, I. (2015). Dampak Perkebunan Kelapa Sawit terhadap Perekonomian Wilayah di Kabupaten Rokan Hulu. *Jurnal Agroteknologi*, 5(2), 7–14.