

DAFTAR PUSTAKA

- Anggraini, S., & Rizqan, A. (2021). Keanekaragaman Gulma Pada Perkebunan Kelapa Sawit (*Elaeis guineensis* Jacq.) Masyarakat Di Desa Batu Melenggang, Kecamatan Hinai, Kabupaten Langkat, Sumatera Utara. *Perbal: Jurnal Pertanian Berkelanjutan*, 9(3), 138-143.
- Barus, E. (2020). Masalah dan pengendalian gulma di perkebunan. Emanuel Barus Publisher.
- BPS. (2023). *Statistik kelapa sawit Indonesia 2022*. Badan Pusat Statistik.
- Chika, S., Sandy, R., & Purnomo, E. (2023). Keanekaragaman Jenis Gulma dan Pengendaliannya pada Perkebunan Kelapa Sawit. *Jurnal Life Science: Jurnal Pendidikan dan Ilmu Pengetahuan Alam*, 5(2), 38-44. <https://doi.org/10.31980/lsciences.v5i2.348>
- Corley, R. H. V., & Tinker, P. B. (2015). *The oil palm* (5th ed.). John Wiley & Sons.
- De Carvalho, D. E., & Callaghan, J. P. (2022). Effect of office chair design features on lumbar spine posture, muscle activity, and perceived pain during prolonged sitting. *Ergonomics*, 1–35. <https://doi.org/10.1080/00140139.2022.2152113>
- De Cauwer, B., De Meuter, I., De Ryck, S., Dekeyser, D., Zwervaegher, I., & Nuytens, D. (2023). Performance of Drift-Reducing Nozzles in Controlling Small Weed Seedlings with Contact Herbicides. *Agronomy*, 13(5), 1342. <https://doi.org/10.3390/agronomy13051342>
- Ditjenbun [Direktorat Jenderal Perkebunan]. (2023). *Buku panduan mekanisasi perkebunan 2023*. Kementerian Pertanian Republik Indonesia.
- el akbar, habib yasin, Resdiar, A., Subandar, I., fajri, M., & Batubara, M. A. (2023). Identifikasi Gulma pada Usia Tanaman Kelapa Sawit (*Elaeis guineensis* Jacq) yang Berbeda pada Tanah Ultisol Di Kebun Jaya Seujahtera PT. ASN. *Biofarm: Jurnal Ilmiah Pertanian*, 19(1), 77–84. <https://doi.org/10.31941/biofarm.v19i1.3022>
- Eltayeb, M., Azmi, N. L., Md Nor, K. A., Toha, S. F., Hashim, A. H. A., & Nordin, N. H. D. (2024). *Investigating the Effects of Backrest Angle on Driver Erector Spinae Muscle Fatigue During Long Drives: A Preliminary Study*. 30, 454–458. <https://doi.org/10.1109/icom61675.2024.10652536>
- Fairhurst, T., & McLaughlin, D. (2009). *Sustainable oil palm development on degraded land in Kalimantan*. World Wildlife Fund.
- FAO. (2023). *Oil crops outlook 2023*. Food and Agriculture Organization.
- GAPKI. (2023). *Indonesian palm oil statistics 2022*. Indonesian Palm Oil Association.

- Hills, D. J., & Gu, Y. (1989). sprinkler Volume Mean Droplet Diameter as a Function of Pressure. *Transactions of the ASABE*, 32(2), 471–0476. <https://doi.org/10.13031/2013.31028>
- Huang, Z., Cui, J., Wang, Y., & Yu, S. (2024). Improving wheelchair user sitting posture to alleviate lumbar fatigue: a study utilizing sEMG and pressure sensors. *Frontiers in Neuroscience*. <https://doi.org/10.3389/fnins.2024.1380150>
- Khatun, R., Reza, M. I. H., Moniruzzaman, M., & Yaakob, Z. (2017). Sustainable oil palm industry: The possibilities. *Renewable and Sustainable Energy Reviews*, 76, 608-619. <https://doi.org/10.1016/j.rser.2017.03.077>
- Koh, L. P. (2008). Can oil palm plantations be made more hospitable for forest butterflies and birds? *Journal of Applied Ecology*, 45(4), 1002–1009. <https://doi.org/10.1111/j.1365-2664.2008.01491.x>
- Kushairi, A., Loh, S. K., Azman, I., Hishamuddin, E., Ong-Abdullah, M., Izuddin, Z. B. M. N., ... & Parveez, G. K. A. (2018). Oil palm economic performance in Malaysia and R&D progress in 2017. *J. Oil Palm Res*, 30(2), 163-195. <https://doi.org/10.21894/jopr.2018.0030>
- Manurung, H., & Wiraguna, E. (2025). Analisis Efisiensi Metode Panen Manual dan Mekanisasi pada Produksi Kelapa Sawit. *Botani: Publikasi Ilmu Tanaman dan Agribisnis*, 2(2), 01-11. <https://doi.org/10.62951/botani.v2i2.288>
- Matsuda, T., Koyama, T., Kurihara, Y., Tagami, M., Kusumoto, Y., & Nitta, O. (2017). A newly developed floor chair placed on an office chair reduces lumbar muscle fatigue by cyclically changing its lumbar supporting shape. *Journal of Physical Therapy Science*, 29(9), 1649–1652. <https://doi.org/10.1589/JPTS.29.1649>
- Nasution A. A., Sopandie D., & Lontoh A. P. (2024). Pengelolaan Gulma Kelapa Sawit (*Elaeis guineensis* Jacq.) di Kebun Negeri Lama Selatan, Sumatera Utara. *Buletin Agrohorti*, 12(1), 1-12. <https://doi.org/10.29244/agrob.v12i1.51386>
- Parveez, G. K. A., Hishamuddin, E., Loh, S. K., Ong-Abdullah, M., Salleh, K. M., Bidin, M. N. I. Z., ... & Idris, Z. (2020). Oil palm economic performance in Malaysia and R&D progress in 2019. *Journal of Oil Palm Research*, 32(2), 159-190. <https://doi.org/10.21894/jopr.2020.0032>
- Pethick, J., & Tallent, J. (2022). The Neuromuscular Fatigue-Induced Loss of Muscle Force Control. *Sports*, 10(11), 184. <https://doi.org/10.3390/sports10110184>
- Saleh, A., Dibisono, M. Y., & Gea, S. U. (2020). Keragaman Gulma pada Tanaman Kelapa Sawit (*Elaeis guineensis* Jacq.) Belum Menghasilkan dan Sudah Menghasilkan di Kebun Rambutan PT. Perkebunan Nusantara III. *Jurnal Agro Estate*, 4(1), 1-10.

- San, C. T., & Kakani, V. (2025). Smart Precision Weeding in Agriculture Using 5IR Technologies. *Electronics*, 14(13), 2517. <https://doi.org/10.3390/electronics14132517>
- Schimmelpfennig, D. (2016). Farm profits and adoption of precision agriculture. *USDA Economic Research Report*, 217, 1–38. <https://doi.org/10.22004/ag.econ.249773>
- Sormin, F., & Junaedi, A. (2017). Manajemen pengendalian gulma kelapa sawit berdasarkan kriteria ISPO dan RSPO di kebun rambutan Sumatera Utara. *Buletin Agrohorti*, 5(1), 137-145. <https://doi.org/10.29244/agrob.v5i1.15902>
- Sumantri, B., Mu'in, A., & Mawandha, H. G. (2024). Perbandingan Pengendalian Gulma Piringan Manual dan Mekanis di Daerah Aliran Sungai Perkebunan Kelapa Sawit. *AGROFORETECH*, 2(3), 1170–1175. Diambil dari <https://jurnal.instiperjogja.ac.id/index.php/JOM/article/view/1433>
- Swandi, F., Rannando, R., Azmi, Y. ., & Mariandy, R. . (2024). Identifikasi Vegetasi Gulma di Lahan Tanaman Belum Menghasilkan (TBM) Kelapa Sawit di Lahan Marginal . *Jurnal Ilmiah Biosaintropis (Bioscience-Tropic)*, 10(1), 70–76. <https://doi.org/10.33474/ejbst.v10i1.590>
- Tampubolon, K., & Purba, E. (2018). Konfirmasi Resistensi Eleusine indica terhadap Glifosat pada Perkebunan Kelapa Sawit di Kabupaten Langkat. *Jurnal Online Pertanian Tropik*, 5(2), 276-283.
- Tummapudi, S. (2023). Deep Learning Based Weed Detection and Elimination in Agriculture. *International Congress on Information and Communication Technology*, 147–151. <https://doi.org/10.1109/ICICT57646.2023.10134186>

LAMPIRAN

Lampiran A. Mini Traktor Semprot Mekanis



Lampiran B. Mini Traktor Semprot Mekanis Hasil Modifikasi



Lampiran C. Penyemprotan Manual



Lampiran D. Penyemprotan Mekanis



Lampiran E. Rotation Direction

POWER TAKE OFF [rpm] and SPEED WITH SINGLE RANGE						Rpm PTO Km/h SPEED
Engine (rpm) Gear	1st	2nd	3rd	4th	5th	RV
1500	152 1.76	265 3.08	409 4.75	557 6.47	681 7.90	158
2000	203 2.35	354 4.10	546 6.33	743 8.62	907 10.53	210
2500	253 2.94	442 5.13	682 7.92	929 10.78	1134 13.16	263
3000	304 3.53	531 6.16	819 9.50	1114 12.93	1361 15.79	316
3600	365 4.23	637 7.39	982 11.40	1337 15.52	1633 18.95	379
Sense of rotation	Clockwise 					Anticlockwise 

Lampiran F. Data Observasi Lapangan

Semprot Secara Mekanis							
No	Tgl	Lokasi Kerja	HM Awal	HM Akhir	Jumlah HM	Hasil Kerja(Ha)	HA per HM
1	05-Sep-24	Div 3	25	30	5	23	4,6
2	06-Sep-24	Div 3	30	35,6	5,6	25	4,5
3	07-Sep-24	Div 3	35,6	41,2	5,6	25	4,5
4	08-Sep-24	Div 3	41,2	47,0	5,8	26	4,5
5	09-Sep-24	Div 3	47,0	52,6	5,6	25	4,5
6	11-Sep-24	Div 3	52,6	58,1	5,5	25	4,5
7	12-Sep-24	Div 3	58,1	63,7	5,6	25	4,5
8	18-Sep-24	Div 3	63,7	69,1	5,4	24	4,4
9	19-Sep-24	Div 3	69,1	74,8	5,7	26	4,6
10	20-Sep-24	Div 3	74,8	80,4	5,6	25	4,5
11	21-Sep-24	Div 3	80,4	86,0	5,6	25	4,5
12	23-Sep-24	Div 3	86,0	91,6	5,6	25	4,5

Semprot Dengan <i>Knapsack Sprayer</i>								
No	Tgl	Lokasi Kerja	Prestasi					
			Nama	Hasil Kerja (Ha)	Nama	Hasil Kerja (Ha)	Nama	Hasil Kerja (Ha)
1	06-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
2	07-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
3	08-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
4	09-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
5	10-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
6	11-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
7	13-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
8	14-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
9	15-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
10	16-Jan-25	Div 3	Suriani	2,5	Andrian	3	Yanti	2,5
11	17-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3
12	18-Jan-25	Div 3	Suriani	3	Andrian	3,3	Yanti	3

Smprot dengan CDA								
No	Tgl	Lokasi Kerja	Prestasi					
			Nama	Hasil Kerja (Ha)	Nama	Hasil Kerja (Ha)	Nama	Hasil Kerja (Ha)
1	06-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
2	07-Jan-25	Div 3	Nurlela	4,5	Banto	5	Rina	5
3	08-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
4	09-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
5	10-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
6	11-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
7	13-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
8	14-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
9	15-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
10	16-Jan-25	Div 3	Nurlela	4	Banto	4,5	Rina	4
11	17-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5
12	18-Jan-25	Div 3	Nurlela	5	Banto	5	Rina	5