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Research Article

Evaluation of The Larvicidal and Growth Inhibitory of Novaluron on Housefly (*Musca domestica*) in a Commercial Poultry Farm

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Abstract. *Musca domestica* is a major pest in poultry farms, contributing to disease transmission and economic losses, while increasing resistance to conventional adulticides necessitates alternative control strategies. Novaluron, a chitin synthesis inhibitor, disrupts larval development by inhibiting exoskeleton formation. This study evaluated the larvicidal and growth inhibitory effects of novaluron on *M. domestica* under semi-field conditions simulating poultry farms in Mabitac, Laguna, Philippines. Third-instar larvae were introduced into poultry manure assigned to three treatments: control, low-dose novaluron (2.32 mg a.i./0.093 m^2), and high-dose novaluron (4.65 mg a.i./0.093 m^2). Larval and pupal counts were recorded on Days 7 and 14 to assess larvacidal efficacy and developmental inhibition, analyzed using the Kruskal–Wallis test with Dwass–Steel–Critchlow–Fligner post hoc comparisons. Novaluron significantly reduced larval survival and pupation in a dose-dependent manner. By Day 14, larval reduction reached 90.98% in the low-dose and 96.07% in the high-dose treatment, while pupal inhibition exceeded 91% in both treatments, significantly outperforming the control. These findings indicate that novaluron is an effective larvicide against *M. domestica* due to its targeted mode of action and relatively lower risk to non-target organisms compared with conventional adulticides and has strong potential for integration into sustainable and resistance-conscious fly management programs in poultry production systems.

Keywords: *Musca domestica*; novaluron; larvicide; insect growth regulator; chitin synthesis inhibitor; poultry farm

1. Introduction

The Philippine poultry industry plays a crucial role in national food security and agricultural sustainability by providing affordable animal protein and supporting rural livelihoods amid increasing consumer demand (Monleon, 2024; United States Department of Agriculture Foreign Agricultural Service, 2024). Poultry meat consumption continues to rise due to population growth, economic development, and changing dietary preferences, with projections indicating a substantial increase by 2050 (Espino & Bellotindos, 2020). However, intensified and high-density poultry production systems have simultaneously increased the prevalence of poultry-associated pests, particularly flies, posing significant risks to animal health, public health, and environmental sustainability.

The common housefly (*Musca domestica*) is one of the most problematic pests in poultry farms, thriving in manure-rich environments and tropical climatic conditions such as those in the Philippines (Dhang, 2018; Miranda et al., 2023). Houseflies are well-documented mechanical vectors of numerous pathogens, including bacteria and parasites associated with zoonotic and foodborne diseases, contributing to disease transmission, reduced poultry productivity, and increased biosecurity costs (Khamesipour et al., 2018; Mendonça de Oliveira et al., 2018; Nayduch & Burrus, 2017). From a One Health perspective, uncontrolled fly populations affect not only poultry health and farm economics but also surrounding communities through environmental contamination and public health risks.

Current fly management strategies in poultry production rely predominantly on chemical adulticides (Licup et al., 2024). Although initially effective, these approaches are increasingly limited by widespread insecticide resistance and concerns regarding environmental persistence, non-target toxicity, and human health impacts (Abbas & Hafez, 2023; Abobakr et al., 2022; Ahmadi et al., 2020; Senthoorraja et al., 2022). Resistance to multiple insecticide classes has

been reported globally, undermining long-term control and highlighting the need for alternative, more sustainable control measures compatible with integrated pest management (IPM) programs. Quantitative evidence of insecticide resistance has also been reported in regional housefly populations. For instance, Philippine strains have exhibited LD_{50} values to malathion ranging from 0.0975 to 1.775 μg per fly, with several field populations demonstrating elevated resistance compared with reference strains, indicating increasing selection pressure from conventional insecticides (Kano et al., 1977).

Insect Growth Regulators (IGRs), particularly chitin synthesis inhibitors such as novaluron, have emerged as promising alternatives due to their targeted action against immature insect stages and reduced non-target effects (Douris et al., 2016; Sun et al., 2015). Previous studies have demonstrated the effectiveness of novaluron against various insect pests, including mosquitoes and agricultural insects, with evidence suggesting enhanced efficacy under higher temperatures typical of tropical environments (A Hamilton et al., 2021; Herath et al., 2024; Mann et al., 2023). Novaluron as a benzoylphenyl urea chitin synthesis inhibitor, it directly disrupts cuticle formation during larval molting, leading to lethal developmental abnormalities. Compared with other insect growth regulators such as juvenile hormone analogs or ecdysone agonists, novaluron has demonstrated strong efficacy against several insect pests, relatively low toxicity to vertebrates and non-target organisms, and good stability under field conditions (Hussain et al., 2019). However, its effectiveness when applied directly to poultry manure under tropical semi-field conditions remains insufficiently documented. A few researchers have explored novaluron for fly control; however, there have been limited studies evaluating its direct application to poultry manure under field-relevant tropical conditions.

Therefore, this research intends to address this gap by evaluating novaluron as a larvicidal and growth-inhibitory agent against *M. domestica* in commercial poultry settings in the Philippines. This study aims to evaluate the larvicidal efficacy of novaluron on *M. domestica* larvae, its growth inhibitory effects on pupal development, and compare the effectiveness of two novaluron concentrations applied directly to poultry manure

2. Method

2.1. Study site and experimental design

The study used poultry manure collected from a private broiler farm in Mabitac, Laguna, Philippines. The farm applied routine sanitation and occasional pyrethrin-based adult fly control but no larvicidal manure treatments. Manure was placed into 27 cardboard boxes (0.093 m^2 each) and randomly assigned to three treatments (Table 1) with nine replicates per group. The collected manure was visually inspected to confirm the absence of naturally occurring fly larvae or pupae. Each unit/box was covered with fine mesh to prevent additional oviposition or colonization by other insects during the experimental period and maintained outdoors under sheltered semi-field tropical conditions.

Table 1. Treatments that were utilized in the experiment trial

Treatment group	Solution Preparation (Dilution Rate)	Dose per Experimental Units (mg a.i./box)
T1 (Negative Control)	Distilled water	0 mg a.i./box
T2 (Low dose)	1 mL of 100 g/L novaluron in 1 L water (1mL/L)	2.32 mg a.i./box
T3 (High Dose)	2 mL of 100 g/L novaluron in 1 L water (2mL/L)	4.65 mg a.i./box

*mg a.i. = milligram active ingredient

2.2. Larval preparation

Third-instar *M. domestica* larvae (5–8 mm) were selected based on uniform size and active movement to ensure consistent starting conditions. A total of 500 larvae were introduced into each manure-filled box. Although standardized containers were used to ensure controlled and replicable experimental conditions, cardboard boxes cannot fully replicate the structural heterogeneity and environmental gradients present in large manure accumulations in commercial poultry farms. Therefore, while the semi-field design provides useful insights into the larvicidal efficacy of novaluron under realistic environmental conditions, further validation under full-scale farm settings is recommended.

2.3. Treatment Application

Novaluron was applied at two concentrations using a handheld sprayer on Day 0 and Day 7. Treatments consisted of an untreated control, 2.32 mg a.i./0.093 m^2, and 4.65 mg a.i./0.093 m^2. Novaluron concentrations were selected based on manufacturer recommendations (10% SC, 100 g a.i./L) and prepared at 1 mL/L and 2 mL/L, corresponding to 2.32

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and 4.65 mg a.i. per box (0.093 m^2), respectively. Fresh solutions were prepared on each application day and applied using uniform handheld sprayers at an equivalent field rate of 250 mL/m^2, adjusted to box surface area. Treatments were applied on Days 0 and 7 under stable weather conditions to ensure consistent larval exposure and simulate standard poultry farm practices.

2.4. Experimental Design

A completely randomized design was employed, consisting of three treatment groups with nine replicates each (n = 27). Each replicate unit consisted of a box containing poultry manure and 500 third-instar larvae. This design enabled statistically robust comparisons of treatment effects on larval survival and development.

Each box was misted daily with water using a 500 mL handheld spray bottle to maintain moisture for larval development and was exposed to natural outdoor conditions throughout the experiment. Ambient temperature and relative humidity were recorded daily, with temperatures ranging from 32–38 °C. Data were collected on Days 0, 7, and 14 to assess larval survival, pupation, and treatment efficacy. Live larvae were identified by response to gentle stimulation, while immobile individuals for ≥15 minutes were recorded as dead and removed.

The following parameters were measured or calculated for each replicate: Number of live larvae, number of formed pupae, average number of live larvae and formed pupae per replicate, percentage larval reduction

Larval reduction was calculated to evaluate the efficacy of the treatments against *M. domestica* larvae. A total of 500 third-instar larvae were introduced into each experimental unit. On Day 7, larval reduction (%) was determined using Eq. (1):

$$\text{Larval Reduction (\%)} = \frac{500-(\text{Live larvae}_{Day\,7}+\text{Pupae}_{Day\,7})}{500} \times 100 \quad (1)$$

On Day 14, cumulative larval reduction was calculated by including surviving larvae and pupae recorded on both Day 7 and Day 14, as expressed in Eq. (2):

$$\text{Larval Reduction (\%)} = \frac{500-(\text{Live larvae}_{Day\,14}+\text{Pupae}_{Day\,7}+\text{Pupae}_{Day\,14})}{500} \times 100 \quad (2)$$

This approach allowed for the assessment of cumulative survival and developmental progression from the initial larval cohort throughout the experimental period.

Pupal inhibition was calculated to determine the effectiveness of the treatments in preventing larval development into the pupal stage. A total of 500 third-instar larvae were introduced into each experimental unit. On Day 7, pupal inhibition (%) was calculated using formula in Eq. (3):

$$\text{Pupal Inhibition (\%)} = \frac{500-\left(\text{Pupae}_{Day\,7}\right)}{500} \times 100 \quad (3)$$

On Day 14, cumulative pupal inhibition was calculated by including pupae recorded on both Day 7 and Day 14, as shown in Eq. (4):

$$\text{Pupal Inhibition (\%)} = \frac{500-(\text{Pupae}_{Day\,7}+\text{Pupae}_{Day\,14})}{500} \times 100 \quad (4)$$

This cumulative approach accounts for all individuals from the initial larval cohort that successfully developed into the pupal stage during the experimental period.

2.4. Data Collection and Analysis

All data were subjected to the Kruskal-Wallis test, a non-parametric alternative to one-way ANOVA, to assess significant differences among treatment groups. When the Kruskal-Wallis test indicated significant effects, Dwass-Steel-Critchlow-Fligner (DSCF) pairwise comparisons were conducted as a post hoc analysis to determine specific group differences. Statistical significance was set at $p < 0.05$. All analyses were performed using Jamovi software (version 2.6.25). At the conclusion of the experiment, all manure, larvae, and containers were incinerated in accordance with biosecurity and ethical guidelines to prevent any unintended environmental contamination or adult fly emergence.

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3. Result and Discussion

3.1. Provide sub section

Control of *Musca domestica* remains a major challenge in tropical poultry systems, necessitating effective larval-targeted interventions. This study evaluated the larvicidal and growth inhibitory effects of the chitin synthesis inhibitor novaluron when applied to poultry manure under semi-field conditions. Three treatments were assessed, including an untreated control, and two novaluron doses with larval and pupal populations monitored on Days 7 and 14. Non-parametric analyses were applied due to non-normal data distribution.

Table 2. Mean larval count in response to varying novaluron concentrations over time.

	T1 (Negative Control)	T2 (Low dose)	T3 (High Dose)
Day 0	500	500	500
Day 7	360.22[a]	170.33[a]	32.33[b]
Day 14	49.56[a]	3.33[a]	2.11[b]

* Means within rows bearing different superscripts (a, b) are significantly different ($p < 0.05$).

Novaluron significantly reduced viable larval densities in a dose-dependent manner (Table 2). On Day 7, mean larval counts declined markedly in treated groups compared with the control. This effect intensified by Day 14, when larval populations were almost completely suppressed in both novaluron treatments. These findings are consistent with previous studies demonstrating the effectiveness of novaluron against *M. domestica*, particularly when applied to manure substrates or through feed-through formulations, resulting in significant reductions in larval survival and adult emergence (Lohmeyer et al., 2014; Lohmeyer & Pound, 2012). Moreover, novaluron has also been shown to exhibit increased efficacy at higher temperatures, supporting its suitability for tropical poultry farm conditions (Khan, 2021). Novaluron exhibits moderate environmental persistence but undergoes degradation through microbial activity, photolysis, and hydrolysis, with degradation rates influenced by temperature, sunlight exposure, and organic matter content. In manure-rich substrates commonly found in poultry farms, microbial processes may facilitate its breakdown, potentially limiting long-term environmental accumulation while maintaining sufficient residual activity for larval control.

Statistical analysis showed significant differences in live larval counts among treatments (Kruskal–Wallis, $\chi^2 = 7.07$, $p = 0.029$), with the high dose treatment significantly fewer larvae than the control (T1; $p = 0.016$). Although T2 showed reduced larval numbers, the differences were not statistically significant. These results confirm the dose-dependent larvicidal effect of novaluron, primarily through disruption of molting via chitin synthesis inhibition (Cetin et al., 2006). On the other hand, a significant reduction in pupal densities was observed following novaluron treatment (Table 3). Mean pupal counts on Day 7 were 125.11 for T1, drastically reduced to 37.11 for T2 and 16.33 for T3. This trend persisted through Day 14, with counts of 57.00 (T1), 4.67 (T2), and 1.22 (T3).

Table 3. Mean pupal count in response to varying novaluron concentrations over time.

	T1 (Negative Control)	T2 (Low dose)	T3 (High Dose)
Day 7	125.11[a]	37.11[b]	16.33[c]
Day 14	57.00[a]	4.67[b]	1.22[c]

* Means within rows bearing different superscripts (a,b,c) are significantly different ($p < 0.05$)

Insect growth regulators (IGRs) disrupt insect development by interfering with hormonal regulation or structural processes essential for molting and metamorphosis (Apolinário & Feder, 2021). Chitin synthesis inhibitors (CSIs) represent an important class of IGRs that inhibit chitin formation, resulting in lethal molting defects and impaired exoskeleton development (Moussian, 2019). Due to their specificity and lower toxicity to non-target organisms, CSIs are considered environmentally compatible and suitable for IPM programs (Smagghe et al., 2019). Novaluron, a benzoylphenyl urea compound, is a widely used CSI with demonstrated efficacy against various insect pests, including filth flies (A Hamilton et al., 2021; Sun et al., 2015). Its mode of action targets larval stages, leading to reduced survival, delayed development, and inhibition of adult emergence (Ghoneim et al., 2017).

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The Kruskal–Wallis test revealed a highly significant difference in pupal numbers among treatments ($\chi^2 = 38.1$, $p < 0.001$), with all pairwise comparisons showing significant differences. This indicates that novaluron effectively inhibits larval–pupal transition and pupal viability through disruption of cuticle formation, a characteristic mode of action of CSIs. These findings are consistent with previous reports of deformed puparia and effective larval control following novaluron application to manure (Lohmeyer et al., 2014; Lohmeyer & Pound, 2012).

Percentage-based analyses confirmed the strong, dose-dependent efficacy of novaluron in reducing larval and pupal populations (Table 4). Larval reduction on Day 7 was minimal in the control (T1: 2.93%) but substantially higher in treated groups (T2: 58.51%; T3: 90.27%), increasing further by Day 14 to 90.98% (T2) and 96.07% (T3). Statistical analysis showed highly significant differences among treatments (Kruskal–Wallis, $\chi^2 = 39.1$, $p < 0.001$), with all pairwise comparisons significant, demonstrating clear dose–response effects consistent with previous findings (Cetin et al., 2006). These reductions reflect novaluron's disruption of chitin synthesis during larval molting, potentially enhanced by tropical temperatures (32–38 °C), as supported by Khan (2021). Comparable to or exceeding earlier reports, these results indicate high larvicidal potency. Consistently, pupal inhibition was also pronounced (Table 5), reaching 91.64–96.49% in novaluron-treated groups by Day 14, further confirming its effectiveness in suppressing immature stages of *M. domestica*.

Biological control agents, particularly parasitoid wasps such as *Spalangia* and *Muscidifurax* spp., play an important role in suppressing housefly populations in poultry manure ecosystems (D'Arco et al., 2025). Due to novaluron primarily targets immature stages through inhibition of chitin synthesis, its direct effects are expected to occur mainly during larval development. Nevertheless, reductions in host availability or potential exposure of parasitoid immatures developing within host pupae could influence parasitoid populations. Previous studies suggest that insect growth regulators are generally more compatible with parasitoid-based biological control than conventional broad-spectrum insecticides; however, species-specific responses may occur. Further studies evaluating the compatibility of novaluron with parasitoid release programs would therefore be valuable.

Table 4. Percentage reduction in larval count across different concentrations of novaluron.

	T1 (Negative Control)	T2 (Low dose)	T3 (High Dose)
Day 7	2.93[a]	58.51[b]	90.27[c]
Day 14	53.67[a]	90.98[b]	96.07[c]

* Means within rows bearing different superscripts (a,b,c) are significantly different ($p < 0.05$)

High pupal inhibition was observed on Day 14, reaching 91.64% and 96.49% in the low- and high-dose novaluron treatments, respectively, demonstrating strong and sustained efficacy consistent with previous reports of >90% suppression of housefly development following novaluron application in manure substrates (Table 5). The slight numerical decline in inhibition between Days 7 and 14 reflects the delayed and staggered developmental disruption typical of insect growth regulators that interfere with chitin synthesis during molting, rather than a loss of efficacy, and was likely mitigated by reapplication on Day 7. A clear dose-dependent response was evident, with the higher concentration consistently outperforming the lower dose, while both treatments significantly exceeded the control. The high efficacy observed under tropical temperatures (32–38 °C) aligns with evidence that novaluron toxicity increases at elevated temperatures, supporting its suitability for tropical poultry systems. Although complete suppression was not achieved, likely due to environmental variability and stage-specific susceptibility, these findings confirm novaluron's larvicidal and growth-inhibitory effectiveness and support its integration into integrated pest management strategies for sustainable housefly control in poultry farms.

Table 5. Percentage inhibition of pupal formation across different concentrations of novaluron.

	T1 (Negative Control)	T2 (Low dose)	T3 (High Dose)
Day 7	74.98[a]	92.58[b]	96.73[c]
Day 14	63.58[a]	91.64[b]	96.49[c]

* Means within rows bearing different superscripts (a, b, c) are significantly different ($p < 0.05$).

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The relatively high larval reduction observed in the control group by Day 14 (53.67%) reflects the natural developmental progression of *M. domestica* larvae rather than treatment-induced mortality. As larvae mature, many individuals transition into the pupal stage, which reduces the number of larvae recorded during later observations. This pattern is supported by the relatively high pupal counts observed in the control treatment, indicating normal life-cycle progression in the absence of larvicidal treatment.

Although insect growth regulators such as novaluron are generally considered more selective than conventional adulticides, their mode of action targeting chitin synthesis may potentially affect other arthropods present in manure ecosystems, including beneficial organisms involved in organic matter decomposition (Cutler et al., 2006).

The present study did not specifically evaluate non-target impacts and ecological effects. Therefore, further research assessing the effects of novaluron on beneficial manure-associated fauna is warranted to ensure its compatibility with sustainable manure management and integrated pest management programs. Future research examining long-term impacts of novaluron on manure decomposition dynamics, microbial activity, and nutrient turnover would be valuable to fully assess its sustainability in poultry farm management.

4. Conclusion

This study demonstrated that novaluron applied under field-simulated conditions in Mabitac, Laguna, Philippines, is effective as a larvicide and growth inhibitor against *Musca domestica*. Both tested concentrations significantly reduced larval and pupal populations, with the higher dose (4.65 mg a.i./0.093 m^2) showing superior, dose-dependent efficacy. The pronounced suppression of immature stages highlights novaluron's potential to disrupt the housefly life cycle and reduce adult emergence, particularly under warm tropical conditions where its activity may be enhanced. Novaluron is therefore recommended for inclusion in integrated pest management (IPM) programs in poultry farms, especially when applied at peak larval activity. However, it should not be used as a stand-alone control measure. Integration with sanitation, manure management, biological control, and rotation or combination with adulticides of different modes of action is essential to delay resistance development and ensure sustainable control. Further studies are recommended to refine dose–response relationships, assess adult emergence and sublethal effects, evaluate non-target impacts, and optimize application strategies to support the long-term use of novaluron in poultry fly management.

References

Abbas, N., & Hafez, A. M. (2023). Alpha-Cypermethrin Resistance in Musca domestica: Resistance Instability, Realized Heritability, Risk Assessment, and Insecticide Cross-Resistance. *Insects*, *14*(3). https://doi.org/10.3390/insects14030233

Abobakr, Y., Al-Hussein, F. I., Bayoumi, A. E., Alzabib, A. A., & Al-Sarar, A. S. (2022). Organophosphate Insecticides Resistance in Field Populations of House Flies, Musca domestica L.: Levels of Resistance and Acetylcholinesterase Activity. *Insects*, *13*(2). https://doi.org/10.3390/insects13020192

Ahmadi, E., Khajehali, J., & Rameshgar, F. (2020). Evaluation of resistance to permethrin, cypermethrin and deltamethrin in different populations of Musca domestica (L.), collected from the Iranian dairy cattle farms. *Journal of Asia-Pacific Entomology*, *23*(2), 277–284. https://doi.org/10.1016/j.aspen.2020.01.014

Apolinário, R., & Feder, D. (2021). Existing potentials in Insect Growth Regulators (IGR) for crop pest control. *Research, Society and Development*, *10*(1), e35910111726. https://doi.org/10.33448/rsd-v10i1.11726

Cetin, H., Erler, F., & Yanikoglu, A. (2006). Larvicidal activity of novaluron, a chitin synthesis inhibitor, against the housefly, Musca domestica. *Journal of Insect Science*, *6*(1), 50. https://doi.org/10.1673/031.006.5001

Cutler, G. C., Scott-Dupree, C. D., Tolman, J. H., & Harris, C. R. (2006). Toxicity of the insect growth regulator novaluron to the non-target predatory bug Podisus maculiventris (Heteroptera: Pentatomidae). *Biological Control*, *38*(2), 196–204. https://doi.org/https://doi.org/10.1016/j.biocontrol.2005.12.016

@The Author(s). 2026. Published by CBIORE

D'Arco, S., Costi, E., Prodi, L., Yatman, T., & Maistrello, L. (2025). Parasitisation activity of Spalangia cameroni and Muscidifurax zaraptor, pupal parasitoids of Musca domestica. *Entomologia Experimentalis et Applicata*, *173*(1), 49–59. https://doi.org/10.1111/eea.13513

Dhang, P. (2018). New challenges in housefly management in poultry farms across The Philippines. *International Pest Control*, *60*(1), 20–21. https://www.proquest.com/scholarly-journals/new-challenges-housefly-management-poultry-farms/docview/2060919080/se-2?accountid=49069

Douris, V., Steinbach, D., Panteleri, R., Livadaras, I., Pickett, J. A., Van Leeuwen, T., Nauen, R., & Vontas, J. (2016). Resistance mutation conserved between insects and mites unravels the benzoylurea insecticide mode of action on chitin biosynthesis. *Proceedings of the National Academy of Sciences*, *113*(51), 14692–14697. https://doi.org/10.1073/pnas.1618258113

Espino, M. T. M., & Bellotindos, L. M. (2020). A System Dynamics Modeling and Computer-based Simulation in Forecasting Long-term Sufficiency: A Philippine Chicken Meat Sector Case Study. *Engineering, Technology & Applied Science Research*, *10*(2), 5406. https://doi.org/10.48084/etasr.3301

Ghoneim, K., Hamadah, K., Mansour, A. N., & Abo Elsoud, A. A. (2017). Toxicity and disruptive impacts of Novaluron, a chitin synthesis inhibitor, on development and metamorphosis of the olive leaf moth Palpita unionalis (Hübner)(Lepidoptera: Pyralidae). *International Journal of Trend in Research and Development*, *4*(3), 184–193. https://doi.org/10.31142/ijtsrd117

Hamilton, J. A., Wada-Katsumata, A., Ko, A., & Schal, C. (2021). Effects of novaluron ingestion and topical application on German cockroach (Blattella germanica) development and reproduction. *Pest Management Science*, *77*(2), 877–885. https://doi.org/10.1002/ps.6092

Herath, J. M. M. K., De Silva, W. A. P. P., Weeraratne, T. C., & Karunaratne, S. H. P. P. (2024). Efficacy of the insect growth regulator novaluron in the control of dengue vector mosquitoes Aedes aegypti and Ae. albopictus. *Scientific Reports*, *14*(1), 1988. https://doi.org/10.1038/s41598-024-52384-x

Hussain, A., AlJabr, A. M., & Al-Ayedh, H. (2019). Development-Disrupting Chitin Synthesis Inhibitor, Novaluron, Reprogramming the Chitin Degradation Mechanism of Red Palm Weevils. *Molecules*, *24*(23). https://doi.org/10.3390/molecules24234304

Kano, R., Cabrera, B. D., Hayashi, A., & Shinonaga, S. (1977). Resistant levels of houseflies to six kinds of synthetic insecticides in the Philippines. *The Southeast Asian Journal of Tropical Medicine and Public Health*, *8*(4), 515–518.

Khamesipour, F., Lankarani, K. B., Honarvar, B., & Kwenti, T. E. (2018). A systematic review of human pathogens carried by the housefly (Musca domestica L.). *BMC Public Health*, *18*(1), 1049. https://doi.org/10.1186/s12889-018-5934-3

Khan, H. A. A. (2021). Posttreatment temperature influences toxicity of insect growth regulators in Musca domestica. *Parasitology Research*, *120*(2), 435–441. https://doi.org/10.1007/s00436-020-06998-5

Licup, B. P. E., Olarve, J. P., Purnamasari, L., & dela Cruz, J. F. (2024). Evaluation of adulticidal efficacy of cypermethrin, tetramethrin, and piperonyl butoxide in housefly (Musca domestica). *JURNAL KESEHATAN LINGKUNGAN*, *16*(3), 222–228. https://doi.org/10.20473/jkl.v16i3.2024.222-228

Lohmeyer, K. H., & Pound, J. M. (2012). Laboratory Evaluation of Novaluron as a Development Site Treatment for Controlling Larval Horn Flies, House Flies, and Stable Flies (Diptera: Muscidae). *Journal of Medical Entomology*, *49*(3), 647–651. https://doi.org/10.1603/ME11220

Lohmeyer, K. H., Pound, J. M., Yeater, K. M., & May, M. A. (2014). Efficacy of Novaluron as a Feed-Through for Control of Immature Horn Flies, House Flies, and Stable Flies (Diptera: Muscidae) Developing in Cow Manure. *Journal of Medical Entomology*, *51*(4), 873–877. https://doi.org/10.1603/ME13196

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Mann, R., Crow, W., Catchot, A. L., Gore, J., Cook, D. R., Stewart, S. D., Thrash, B., & Bateman, N. (2023). Residual effects of novaluron and efficacy of subsequent applications to control mid-south tarnished plant bug (Hemiptera: Miridae) populations. *The Journal of Cotton Science*, *27*(1), 37–42. https://doi.org/10.56454/KXUX1316

Mendonça de Oliveira, T., Mara Teixeira, C., de Lourdes Araujo, I., do Carmo Rezende, L., Maciel Cunha, L., de Lima Castro Filho, R. P., Araújo Diniz, S., & Xavier Silva, M. (2018). Epidemiological characterization and risk assessment associated with the presence of Diptera order in laying poultry farms. *Acta Scientiae Veterinariae*, *46*, 1. https://doi.org/10.22456/1679-9216.83468

Miranda, C. D., Cammack, J. A., & Tomberlin, J. K. (2023). Large-scale production of house fly, Musca domestica (Diptera: Muscidae), larvae fed 3 manure types. *Journal of Economic Entomology*, *116*(4), 1102–1109. https://doi.org/10.1093/jee/toad099

Monleon, A. M. (2024). Futures of Livestock Industry from the Viewpoints of Jurisprudence and Regulatory Measures in the Philippines. In S. Kukovics (Ed.), *Animal Husbandry - Beliefs, Facts and Reality*. IntechOpen. https://doi.org/10.5772/intechopen.1006056

Moussian, B. (2019). Chitin: Structure, Chemistry and Biology. In Q. Yang & T. Fukamizo (Eds.), *Targeting Chitin-containing Organisms* (pp. 5–18). Springer Singapore. https://doi.org/10.1007/978-981-13-7318-3_2

Nayduch, D., & Burrus, R. G. (2017). Flourishing in Filth: House Fly–Microbe Interactions Across Life History. *Annals of the Entomological Society of America*, *110*(1), 6–18. https://doi.org/10.1093/aesa/saw083

Senthoorraja, R., Senthamarai Selvan, P., & Basavarajappa, S. (2022). Eco-Smart Biorational Approaches in Housefly Musca domestica L. 1758 Management. In S. De Mandal, G. Ramkumar, S. Karthi, & F. Jin (Eds.), *New and Future Development in Biopesticide Research: Biotechnological Exploration* (pp. 281–303). Springer Nature Singapore. https://doi.org/10.1007/978-981-16-3989-0_12

Smagghe, G., Zotti, M., & Retnakaran, A. (2019). Targeting female reproduction in insects with biorational insecticides for pest management: a critical review with suggestions for future research. *Current Opinion in Insect Science*, *31*, 65–69. https://doi.org/https://doi.org/10.1016/j.cois.2018.10.009

Sun, R., Liu, C., Zhang, H., & Wang, Q. (2015). Benzoylurea Chitin Synthesis Inhibitors. *Journal of Agricultural and Food Chemistry*, *63*(31), 6847–6865. https://doi.org/10.1021/acs.jafc.5b02460

United States Department of Agriculture Foreign Agricultural Service. (2024). *Philippines: Poultry and Products Annual*. https://www.fas.usda.gov/data/philippines-poultry-and-products-annual

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