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RESEARCH ARTICLE
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Ethnobotanical and Phytochemical Insights on Insecticidal Plants in the Philippines for Sustainable Crop Protection: A Systematic Review and Network Analysis

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ABSTRACT

The growing threat of insect pests and rising global human population in crop production drives farmers to rely on synthetic pesticides, but its misuse threatens health and the environment. Botanical insecticide offers a sustainable biochemical alternative in integrated pest management (IPM). This review integrates ethnobotany, phytochemistry, and taxonomy to identify insecticidal plants utilized by indigenous and local farmers in the Philippines. Following the PRISMA guidelines, 32 unique studies of high methodological quality and low bias risk selected from electronic databases (ScienceDirect, PubMed, and Wiley Online Library) and expanded search (Google Scholar and ResearchGate) were gathered from June 2024 to December 2024. A total of 112 primarily native plant species across 91 genera and 45 families were reported with insecticidal properties. Fabaceae, Asteraceae, and Lamiaceae were the most reported families, with *Capsicum*, *Cymbopogon*, and *Gliricidia sepium* as the most cited genera and species. Less explored species *Coriaria intermedia*, *Selliguea taeniata*, *Homalanthus fastuosus*, and *Tetrapilus borneensis* were also documented. Leaves were the most used plant part, extracted mainly through mechanical methods and applied via direct spraying. Network analysis identifies plant species used against key rice and corn pests, rice bugs, black bugs, and armyworms, providing a basis for further exploration of potential application against emerging global pest fall armyworm, *Spodoptera frugiperda*. Botanical bioactive compounds identified can lead to growth abnormalities, feeding deterrence, and mortality. This review underscores traditional knowledge in sustainable pest management. Further phytochemical, toxicological, and pharmacokinetic studies are needed to validate efficacy and safety for broader application.

Keywords: Insecticidal plants, Pest management, Ethnobotany, Crop protection

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INTRODUCTION

Invasive insect pests and plant diseases threaten global agriculture by causing 40% of annual crop yield loss, equating to nearly $220 billion globally (FAO, 2021). Of this, crop-damaging insects alone account for $70 billion economic loss (Gula, 2023). With the human population expected to reach 10 billion by 2050 (UNCTAD, 2022), securing an increase in crop production to meet demands has become a priority. There is a need for an immediate solution for insect pest management with the growing concern of significant crop loss in rice (30.3%), corn (22.5%), wheat (21.5%), soybean (21.4%) and potato (17.2%) continue to rise (Savary et al., 2019; Ristaino et al., 2021) Currently, an increase in the adoption and application of synthetic pesticides has been recorded, as small-scale farmers prefer accessible, quick, and effective control strategies to manage insect pests (Sharma et al., 2019; Lengai et al., 2020). However, these practices do not come without grave consequences, as pesticide misuse and overdependency have significant damage to the environment and detrimental effects on human health (Rani et al., 2021). Insufficient pesticide policies worsen biodiversity loss and climate change by allowing persistent chemicals to pollute and degrade soil.

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Integrated pest management (IPM) approaches utilize environmentally friendly methods to counter pests and minimize synthetic pesticide dependency. Identified agricultural IPM starts from soil preparation, forecasting, and planting, followed by pest trapping, monitoring, and threshold, in-depth control methods focused on cultural, biological, and chemical control strategies, and finalized by recordkeeping for future reference (IPM Institute, 2024). Botanical insecticides are a good addition to the chemical control aspect, as it aids the biological control methods by providing target-pest specificity and reducing synthetic insecticide use for residue-free crops (Hikal et al., 2017). Farmers in Asia and Africa have traditionally utilized plants with insecticidal properties since 3000 BCE and continue to serve as a cheap, accessible and biodegradable alternative to harmful synthetic pesticides (Souto et al., 2021; Fenibo et al., 2023). In agricultural communities and indigenous groups in Africa, South America, and Asia, insecticidal plants utilization for crop and human protection are observed when synthetic pesticides are not readily accessible and affordable (Gou et al., 2020; Ali et al., 2022; Pila & Maqueda, 2023).

Pesticides remain important in crop protection, yet there is a growing demand for target-pest-specific and eco-friendly botanical alternatives in agricultural IPM. The Philippines, a mega-biodiverse country that harbors over 9,250 vascular plant species, with one-third of these being endemic (Skouloudis et al., 2019; Romeroso et al., 2021). Yet, research on insecticidal plant potential remains limited. While ethnobotanical knowledge on plant use is well-documented, most studies focus on medicinal applications rather than pest management (Fiscal et al., 2016; Cabanlit et al., 2024). This gap is relevant for middle to low-income countries facing ongoing transboundary plant pest invasions, such as the fall armyworm (*Spodoptera frugiperda*) in the Philippines targeting staple crops (Labonete et al., 2024). The identification of insecticidal potential of native plants in the Philippines offers an opportunity for exploration of global sustainable pest control solutions. This study aims to identify insecticidal plants collected, extracted, and applied by indigenous people (IPs) from varying ethnic groups and local farmers in the Philippines through a Preferred Reporting Items for Systematic reviews and Meta-Analyses (PRISMA)-guided systematic review and Gephi-based network analysis.

MATERIALS & METHODS

Databases and Search Strategy

The systematic review was carried out from inception to December 5, 2024, following the PRISMA flow diagram (Page et al., 2021) (Fig. 1). Three electronic databases (ScienceDirect, PubMed, and Wiley Online Library) and expanded search (Google Scholar and ResearchGate) were systematically searched three different times: June, August, and October 2024 to explore published ethnobotanical studies and local farmers' surveys on the taxonomy and geographic distribution of insecticidal plants in the Philippines. These databases were chosen for their comprehensive coverage, open-access content, credibility, reputation, prior use in reviews, and accessibility. After gathering relevant citations, a backward reference search from screened articles was also conducted. The search strategy was formulated based on the repetitive process of trial and error to find the right combinations and Boolean operators to generate the most citations per hit. Filters were applied and curated based on the type of database and expanded searches to optimize the number of relevant citations retrieved. Citations were gathered using the citation management tool Zotero version 7 (Ivey & Crum, 2018).

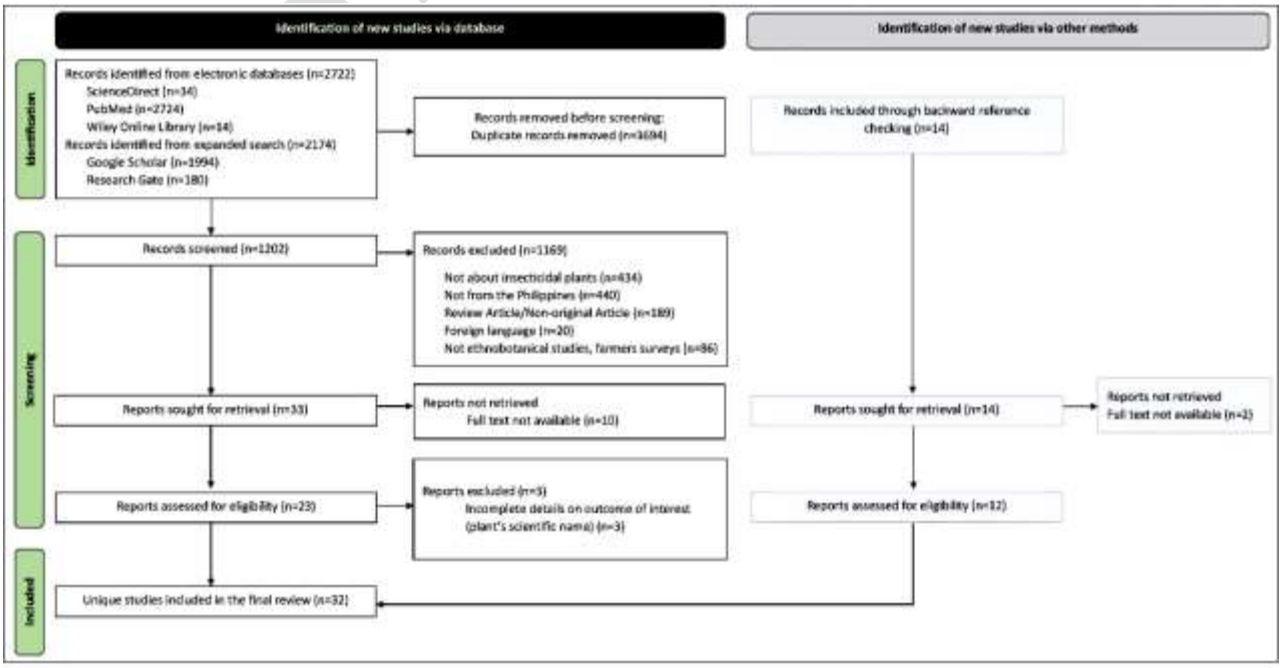

Fig. 1: PRISMA flow diagram of the review on Philippine insecticidal plants.

Study Screening, Extraction and Synthesis

Pre-screening duplicate detection was conducted in Zotero, where duplicate citations were removed. The generated pool of citations was exported and then imported for screening to Rayyan, a research tool that aids in screening of data for systematic review, where it underwent three phases of filtering process to ensure the relevance of the chosen unique articles to the established research objectives (Ouzzani et al., 2016). The review process involved three phases: 1) the identification phase, where duplicate studies are eliminated; 2) the screening phase, where titles and abstracts are examined for the exclusion of irrelevant studies; and 3) eligibility phase where full texts are downloaded, and backward reference search was conducted (Alamgir et al., 2021). The criteria for citation eligibility as unique studies are established to serve as a guide for an organized review. Ethnobotanical studies and local farmers' surveys primarily focusing on insecticidal plants in the Philippines were mainly included. Only primary, open-access, peer-reviewed, and English-language studies and conference papers were considered, and materials encompassed reviews, letters, news, books, protocols, posters, pre-prints, and studies not related to insecticidal plants in the Philippines. A total of 32 unique studies were included in the final review (Fig. 1). The citations were downloaded and tabulated using Microsoft Excel, where data were classified based on taxonomy and classification (scientific name, common name, and local name), plant part/s used, extraction and application method, target insect pest/s, plant status (native, naturalized, cultivated), claimant/s (ethnic groups, locals, indigenous people), Philippine region located, and citation/s. Suppose the same plant species appears multiple times within a single citation for different categories (plant part(s) used, extraction, and application method), in that case, the taxonomic fields (family, scientific name, local name, and common name) were duplicated. However, during taxonomic data sorting and classification, these duplicates were removed to ensure each species is counted only once per source, allowing for accurate analysis.

Quality and Bias Risk Assessment

Four independent reviewers, HJPL, EAJ, MAJT, and CGD classified all included articles and subjected them to study quality assessment using the Mixed Method Appraisal Tool (MMAT) is a critical appraisal tool that assesses various study areas, including qualitative and ethnography studies (Hong et al., 2018). Each criterion was scored 1 for yes, 0 for no, and CT for cannot tell. The points ratio was computed as the total scores of each article, classified as low (≤0.5), moderate-low (0.51-0.65), moderate-high (0.66-0.79), or high (≥0.80) quality study. Bias risk assessment was subsequently conducted using the Risk of Bias in Nonrandomized Studies of Interventions (ROBINS-I) tool. This tool is designed explicitly for nonrandomized studies, including cohort studies, case-control studies, and observational research (Sterne et al., 2016). The quality assessment was determined across seven domains (confounding, participant selection, classification of interventions, deviations from the intended intervention, missing data, measurement of outcomes, and selection of reported results), providing an overall assessment of the bias risk as "low," "moderate," "serious," or "critical." The Robvis tool, a web app designed for visualizing risk-of-bias assessments performed as part of a systematic review, was utilized to generate traffic light plots for question-based judgments and weighted bar plots for the distribution of risk-of-bias within each domain.

Taxonomic Verification

Plant names were standardized using three botanical databases - The World Flora Online (WFO), Plants of the World Online (POWO), and Global Biodiversity Information Facility (GBIF). To achieve consistency and accuracy of taxonomic identification, these databases identified accepted names and known synonyms to minimize errors. Search engines List of the Philippine Traditional Knowledge Digital Library on Health by the National Drug Information Center were used to validate and cross-examine the common name and local name of identified insecticidal plants. Lastly, Co's Digital Flora of the Philippines (CDFP) was used to determine the classification and origin of insecticidal vascular plant species, either native, naturalized, or cultivated in the Philippines.

Plant-insect Pest Network Analysis

The network analysis was conducted using the free application Gephi software (version 0.10.1, released in 2023). Plants that target specified insect pests were included in the study. Edge and node files were initially generated from the collected data and saved as CSV files. The node file, which represents the individual entities in the network, has three columns: the "ID" refers to the shortened scientific names of the organisms, the "Label" composed of the full scientific names of the organisms, and the "Type" classifies the organism, whether they are Plant or Pest. The edge file defines the relationship between nodes and is divided into four columns, "Source" refers to the shortened scientific name of the insecticidal plant, "Target" refers to the target insect pest, "Type" defines the relationship between the two prior entities, classified by either directed or undirected, and "Frequency" referring to the number of citations of the relationship between the plant species and the target insect. The CSV files were imported to the Gephi data laboratory for network assessment and visualization. The directed network graph identified 49 nodes and 75 edges. The chosen network layout was Yifan Hu as it is a clear force-directed algorithm that reduces node overlap and edge congestion. The specific parameters are an optimal distance of 100, a relative strength of 0.2, and an initial step size of 30.0. Nodes were sized according to degree, ranging from 10 to 40, and grouped by assigned type color.

Bioactive Compound Visualization

Identified biochemical compounds from plants with insecticidal properties were visualized using ChemDraw Pro version 8.0, with the SDF file containing coordinates for chemical structure depiction downloaded from PubChem, an open chemistry database at the National Institutes of Health (NIH) (Kim et al., 2025). Data gathered from the included studies were presented in tabular form, organized, and graphed using Microsoft Excel, Canva, and Numbers.

RESULTS

Study Selection and Bias Assessment

The search strategy generated a total of 4896 records for three separate hits, with 34 studies from ScienceDirect, 2724 studies from PubMed, 14 studies from Wiley Online Library, 1994 studies from Google Scholar, and 180 studies from Research Gate. There were 14 studies identified through backward reference checking. After duplicate removal, screening, and exclusion by citation eligibility (Fig. 1), a total of 32 unique studies were included in the final review. As this systematic review explores insecticidal plants, the studies included do not focus only on agricultural insect pests but also include hematophagous insects that may infest other organisms. Out of 32 studies, MMAT classifies 27 (84.4%) as high quality, 1 (3.1%) as moderate-high quality, and 4 (12.5%) as moderate-low quality (Table 1). This suggests all classified studies have great methodological quality and reliability. Summary plots of bias risk assessment results from ROBINS-I show 15 (46.8%) studies were rated with an overall "low" risk of bias, 11 (34.4%) were rated "moderate," and 6 (18.8%) studies were rated "serious" (Fig. 2). The presence of a serious risk of bias in key domains (confounding, participant selection, and measurement of outcomes) suggests that bias may arise as included studies are non-experimental and are often non-randomized. Ethnobotanical studies and survey research are usually subjected to biases (Silva et al., 2022; Singh & Tir, 2023). In this review, qualitative and quantitative surveys on farmers and ethnobotanical studies are susceptible to biases due to the nature of the study, with the specificity of demographic groups (elders and Indigenous people), reliance on participant recall, availability of key informants, and variation in cultural knowledge. Overall, most of the studies have high quality and low overall bias risk. However, only 3 (9.4%) articles have consulted a taxonomist for the verification of insecticidal plants in the Philippines. This is likely due to the primary focus of most included studies being on the efficacy of insect pest control rather than the identification and classification of insecticidal plants.

Annual Trends and Geographic Distribution

Studies with data on the insecticidal application of plants in the Philippines have been developed over the years. The oldest record was published in 1986, in the work by Fujisaka (1986) entitled Pioneer Shifting Cultivation, Farmer Knowledge, and an Upland Ecosystem: Co-Evolution and Systems Sustainability in Calminoe, Philippines. From 2011 to 2014, studies on insecticidal plants peaked, yet fluctuated during the succeeding years. However, a growing interest started again in 2020. This could be accounted by the increase of demands for alternative pest control methods due to the spread of new transboundary plant pests, growing concerns over the environmental and health impacts of synthetic pesticides, and the increasing recognition of ethnobotanical knowledge in sustainable pest management. Yet, studies remain limited despite the large number of indigenous farming communities and ethnic groups in the Philippines (Fig. 3).

Table 1: Quality assessment of the included studies using Mixed Methods Appraisal Tool (MMAT)

Citation	QUALITATIVE STUDIES					QUANTITATIVE DESCRIPTIVE STUDIES					MIXED METHODS STUDIES					Total	Score	Quality
	1.1	1.2	1.3	1.4	1.5	4.1	4.2	4.3	4.4	4.5	5.1	5.2	5.3	5.4	5.5			
Nicolas and Cabarogias (2015)	1	1	1	1	1											5\5	1	High
Villanueva and Buot (2020)						1	1	1	CT	CT						3\5	0.6	Moderate low
Galvez (2021)	1	1	1	1	1	1	0	1	CT	1	1	1	1	0	CT	11\15	0.73	Moderate high
Angagan et al. (2010)	1	1	1	1	1											5\5	1	High
Horgan et al. (2023)	1	1	1	1	1	1	1	1	1	1	1	1	1	CT	1	14\15	0.93	High
Alburo and Olofson (1987)	1	1	1	1	1											5\5	1	High
Rivera (2015)	1	1	1	1	1											5\5	1	High
Obico and Ragragio (2014)						1	1	1	0	1						4\5	0.8	High
Fujisaka (1986)						1	CT	1	CT	1						3\5	0.6	Moderate low
Tuan (2019)						1	1	1	0	1						4\5	0.8	High
Abas (2014)	1	1	1	1	1											5\5	1	High
Lutap and Atis (2013)						1	1	1	1	1						5\5	1	High
Taguiling (2013)						1	0	1	CT	1						3\5	0.6	Moderate low
Conrado and Antonio (2016)						1	0	1	1	1						4\5	0.8	High
Valdez (2023)	1	1	1	1	1	1	0	1	1	CT	1	1	1	0	1	12\15	0.8	High
Narvaez (2019)	1	1	1	1	1											5\5	1	High
Balangcod and Balangcod (2009)	1	1	1	1	1											5\5	1	High
Salomon et al. (2014)	1	1	1	1	1												1	High
Agduma et al. (2011)						1	1	1	1	CT						4\5	0.8	High
Ragragio et al. (2013)	1	1	1	1	1											5\5	1	High
Edaño and Zamora (2009)	1	1	1	1	1											5\5	1	High
Madjos and Ramos (2021)	1	1	1	1	1	1	1	1	0	1	CT	1	1	CT	1	12\15	0.8	High
Allig (2017)						1	1	1	CT	1						4\5	0.8	High
Gascon (2011)	1	1	1	1	1	1	1	1	CT	1	1	1	1	CT	1	13\15	0.867	High
Arangote (2018)	1	1	1	1	1											5\5	1	High
Concepcion et al. (2011)	1	1	1	1	1											5\5	1	High
Aguilar et al. (2014)	1	1	1	1	1	1	0	1	1	1	1	1	1	1	1	14\15	0.93	High
Casio et al. (2021)	1	1	1	1	1	1	1	1	1	1	1	1	1	CT	1	14\15	0.93	High
Galvez (2017)						1	0	1	1	CT						3\5	0.6	Moderate low
Mendez et al. (2021)	1	1	1	1	1	1	1	1	CT	CT	1	1	1	1	1	13\15	0.867	High
Villegas et al. (2014)	1	1	1	1	1	1	1	1	CT	CT	1	1	1	1	1	13\15	0.867	High
Villegas-Pangga (2013)	1	1	1	1	1	1	1	1	CT	1	1	1	1	1	1	14\15	0.93	High

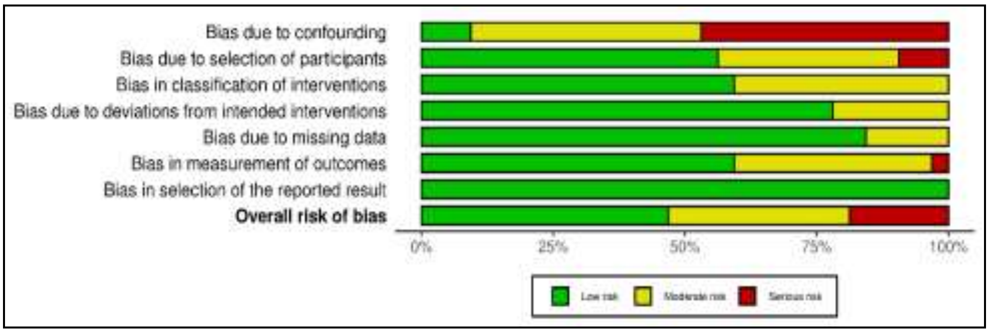

Fig. 2: Summary plots of the risk of bias assessments via Risk of Bias in Non-randomized Studies of Interventions tool (ROBINS-I).

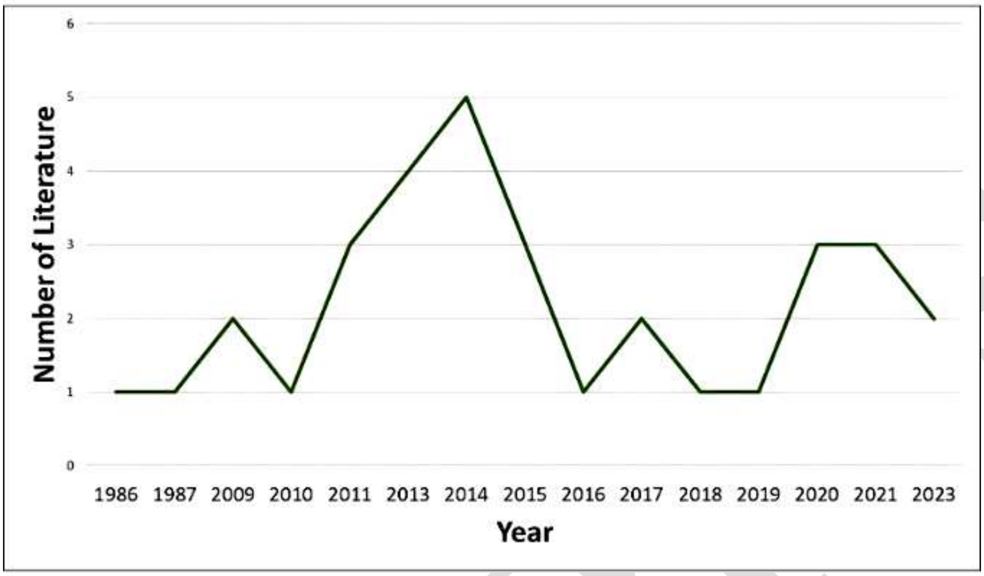

Fig. 3: Annual trend of the number of studies with data on insecticidal plants used in the Philippines.

The geographic distribution of the included studies showcases the diversity of culture and ecosystem in the Philippines, being an archipelagic country. A total of 18 (56.3%) studies were obtained from Luzon, 7 (21.9%) from Visayas, 6 (18.8%) from Mindanao, and 1 (3.1%) from various regions of the country. Luzon, specifically Region IV-A (CALABARZON) and Cordillera Administrative Region (CAR), home to *Isnag/Apayao*, *Ifugao*, *Kalanguya*, and *Tulgao* tribes, as well as local farmers growing rice and vegetables, has the highest number of studies with five papers from each region. This was followed by Region II (Cagayan Valley), Region III (Central Luzon), Region VI (Western Visayas), and Region XII (SOCCSKSARGEN) with three studies each, and Region V (Bicol Region), Region VII (Central Visayas), Region VIII (Eastern Visayas), Region X (Northern Mindanao), and Region XI (Davao Region) with two studies each. Region I (Ilocos Region), MIMAROPA, Region IX (Zamboanga Peninsula), and the Bangsamoro Autonomous Region in Muslim Mindanao (BARMM) have one study each. No articles were obtained from Region XIII (Caraga Region) (Fig. 4). In terms of farming communities, regions such as Region X (Northern Mindanao), Region II (Cagayan Valley), Region III (Central Luzon), and Region VII (Central Visayas) recorded the highest crop production on 2023 (Philippine Statistics, 2024) which accounts for the abundance of studies on local farmers and their utilization of organic insecticides from plants in these regions.

Diversity of Insecticidal Plants in the Philippines

A total of 112 species (Spc) of plants with insecticidal properties were identified and distributed across 91 genera (Gen) and 45 families (Fam) (Table 2). Fabaceae (Legume, pea, or bean Family) was recognized as the family with the most utilized genera (13 counts, 14.3%) and species (14 counts, 12.5%) (Fig. 5). The other families with an abundant number of species used as botanical insecticide were Asteraceae (Aster, daisy, composite, or sunflower family) (Gen: 8 counts, 8.8%; Spc: 11 counts, 9.8%), Lamiaceae (Mint family) (Gen:7 counts, 7.7%; Spc: 9 counts, 8%). Commonly utilized plant families were likely chosen due to their widespread distribution to rain-fed tropical regions like the Philippines as well as their documented efficacy as botanical pesticides (Ebadollahi et al., 2020; Rolnik & Olas, 2021; Raj et al., 2022; Matos & Cunha, 2023). The prevalent use of Fabaceae, Asteraceae, and Solanaceae species as botanical insecticides in traditional practices has also been observed in Sub-Saharan Africa suggesting broad ethnobotanical trends in global agricultural communities (Shilaluke & Moteetee, 2019). The Fabaceae (Leguminosae) family, the third largest plant family with approximately 745 genera and 19,500 species has the most mentioned genera and species in this review (Raj et al., 2022). Legumes are known for nitrogen fixation and can produce nitrogen containing secondary metabolites such as glucosinolates, amines, flavonoids, alkaloids, terpenoids, tannins, and phenolics which are highly toxic to herbivores likely explaining prevalent use in pest management strategies (Wink, 2013; Noviany et al., 2023). The Asteraceae family, containing more than 25,000 species distributed over 1600 genera exhibits strong insecticidal activities by various species resistance to insect attack (Boussaada et al., 2008; Rolnik & Olas, 2021).

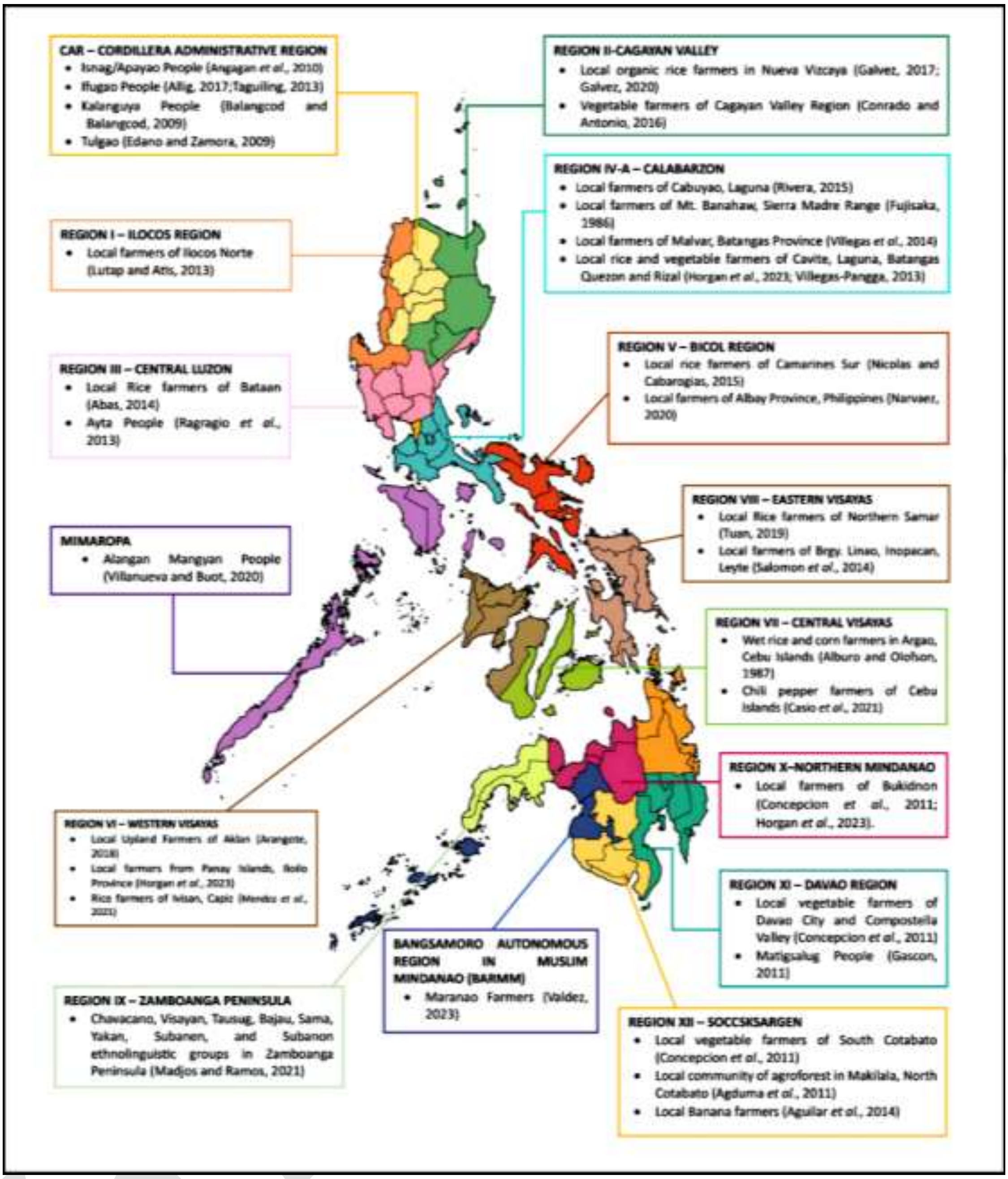

Fig. 4: Claimants (ethnic groups/IPs, local farmers) of the studies with data on insecticidal plants used in the Philippines by region.

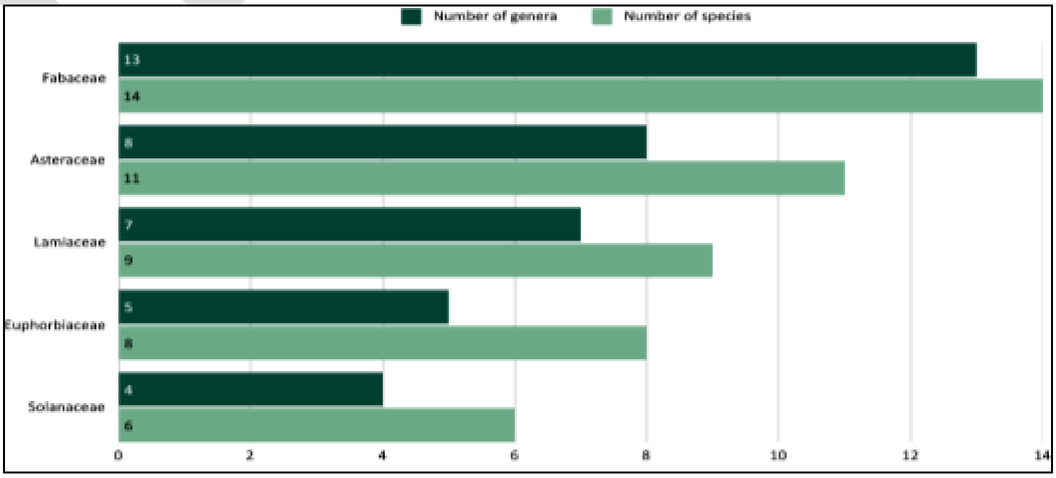

Fig. 5: Five traditionally used plant families with the highest number of species and genera used as botanical insecticide by claimants (ethnic groups/IPs, local farmers) in the Philippines.

Table 2: List of insecticidal plants traditionally used by local farmers, ethnic groups, and indigenous peoples in the Philippines

Family	Scientific Name	Common Name	Local Name	Plant part/s used	Extraction method	Application method	Target Pest	Plant Origin	Claimants	Region	Author/s
Acanthaceae	*Andrographis paniculata* (Burm.f.) Wall. ex Nees	King of Bitters	Sinta	Leaves	Fermentation and aqueous extraction (water)	Direct spray on crops	Insect pests (rice, vegetables)	Naturalized	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
Amaryllidaceae	*Allium cepa* L.	Onion	Sibuyas	Bulbs	Aqueous extraction (water)	Direct spray on crops	Insect pests	Cultivated	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
	Allium cepa L.	Onions	Sibuyas	Bulbs	Aqueous extraction (water)	Direct spray on crops	Insect pests	Cultivated	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)
	Allium sativum L.	Garlic	Bawang	Bulbs	Aqueous extraction (water)	Direct spray on crops	Insect pests	Cultivated	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
	Allium sativum L.	Garlic	Bawang	Whole plant	Aqueous extraction (detergent/soap)	Direct spray on insect, spray on crops	Insect pests	Cultivated	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Allium sativum L.	Garlic	Bawang	Bulbs	Fermentation, mechanical extraction	Direct spray on crops	Crawling insects	Cultivated	Vegetable farmers of Cagayan Valley Region, Northern Philippines	Region II (Cagayan Valley)	(Conrado & Antonio, 2016)
	Allium fistulosum L.	Spring onion	Sibuyas dahon	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Cultivated	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Anacardium occidentale L.	Cashew	Kasoy	Leaves	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Anacardiaceae	*Mangifera indica* L.	Mango	Mangga	Leaves,Seeds	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Mangifera indica L.	Mango	Mangga	Leaves	Air dried	Burning, direct spray on crops	Insect pests	Naturalized	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
Annonaceae	*Annona muricata* L.	Soursop	Guyabano	Leaves	Air dried	Burning	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Annona muricata L.	Soursop	Guyabano	Leaves,Fruits	Not specified	Not specified	Insect pests	Cultivated	Ayta People	Region III (Central Luzon)	(Agduma et al., 2011)
	Annona squamosa L.	Sugar Apple	Atis	Leaves	Aqueous extraction (detergent/soaps), air dried	Direct spray on crops, burning	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius)	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Phaeanthus ophthalmicus (Roxb. ex G.Don) J.Sinclair	Phaeanthus	Amyung	Leaves	Air dried, mechanical extraction	Burning, topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Apocynaceae	*Hoya pubicalyx* Merr.	Wax plant	Haguyopyop	Whole plant	Mechanical extraction	Direct spray on crops, direct spray in the field	Cutworms, Armyworms (Noctuidae)	Native	Ifugao People	CAR	(Allig, 2017)
	Tabernaemontana pandacaqui Poir.	Banana bush	Pandakake	Fruits (endocarp)	Mechanical extraction, boiling	Household repellence	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Tabernaemontana pandacaqui Poir.	Milkwood	Pandakaki puti	Leaves, fruits	Mechanical extraction	Direct spray on crops, direct spray in the field	Diamond backmoth (*Plutella xylostella* Linnaeus), Stemborers	Native	Ifugao People	CAR	(Allig, 2017)
Arecaceae	*Areca catechu* L.	Areca	Bunga	Leaves	Air dried	Burning, direct spray on crops	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Areca catechu L.	Areca	Bunga	Fruits, leaves	Mechanical extraction	Direct spray on crops, direct spray in the field	Rice bug (*Leptocorisa acuta* Thunberg), Leaf folder (*Cnaphalocrocis medinalis* Guenée), Armyworms (Noctuidae),	Native	Ifugao People	CAR	(Allig, 2017)
	Cocos nucifera L.	Coconut	Niyog	Leaves, barks	Mechanical extraction, essential oil extraction	Topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Cocos nucifera L.	Coconut	Niyog	Fruits, (husk)	Air dried	Burning	Insect pests	Native	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
	Cocos nucifera L.	Coconut	Niyog	Fruits	Essential oil extraction	Topical application	Mosquito	Native	Matigsalug People	Region XI (Davao Region)	(Gascon, 2011)
Asparagaceae	*Asparagus officinalis* L.	Asparagus	Aguhuan	Leaves	Air dried	Burning	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Asteraceae	*Calendula officinalis* L.	Pot marigold		Whole plant	Not extracted	Inter-cropping	Insect pests	Introduced (Non-native)	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)

	Calendula officinalis L.	Pot marigold	Calendula	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Naturalized	Banana farmers	Region XII (SOCCSKSARGEN)	(Aguilar et al., 2014)
	Chromolaena odorata (L.) R.M.King & H.Rob.	Siam Weed	Hagonoy	Leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Chromolaena odorata (L.) R.M.King & H.Rob.	Siam Weed	Hagonoy	Leaves	Aqueous extraction (water, detergent/soaps)	Direct spray on crops	Insect pests	Naturalized	Alangan Mangyan People	MIMAROPA	(Villanueva & Buot, 2020)
	Cosmos sp. Cav.	Cosmos	Cosmos	Whole plant	Not extracted	Inter-cropping, trap cropping	Insect pests	Naturalized	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Cosmos sp. Cav.	Cosmos	Cosmos	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests (rice)	Naturalized	Rice farmers of Ivisan, Capiz	Region VI (Western Visayas)	(Mendez et al., 2021)
	Erigeron sumatrensis Retz.	Hairy fleabane	Laglagit	Leaves, stem	Mechanical extraction, aqueous extraction (water, detergent/soaps)	Direct spray on crops, direct spray in the field	Cutworms, Armyworms (Noctuidae)	Naturalized	Ifugao People	CAR	(Allig, 2017)
	Helianthus annuus L.	Common Sunflower	Mirasol	Leaves	Mechanical extraction	Direct spray on crops	Insect pests	Cultivated	Tulgao	CAR	(Edaño & Zamora, 2009)
	Mikania cordata (Burm.f.) B.L.Rob.	Heartleaf hempvine	Bikas	Leaves,stems	Mechanical extraction, air dried	Topical application, burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Annona muricata Kunth	American Rope	Malakamote	Not specified	Not specified	Not specified	Insect pests	Naturalized	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Tagetes erecta L.	Marigold	Marigold	Whole plant	Fresh direct application	Guard planting	Insect pests	Naturalized	Vegetable farmers of Cagayan Valley Region, Northern Philippines	Region II (Cagayan Valley)	(Conrado & Antonio, 2016)
	Tagetes patula L.	French marigold	Amarillo	Whole plant	Not extracted	Inter-cropping	Insect pests	Naturalized	Local farmers of Cabuyao, Laguna	Region IV-A (CALABARZON)	(Rivera, 2015)
	Tagetes sp. L.	Marigold	Amarillo	Whole plant	Not extracted	Inter-cropping, trap cropping	Insect pests	Naturalized	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
	Tagetes sp. L.	Marigold	Amarillo	Whole plant	Not extracted	Inter-cropping	Insect pests	Naturalized	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
	Tagetes sp. L.	Marigold	Amarillo	Whole plant	Not extracted	Inter-cropping, trap cropping	Insect pests	Naturalized	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Tagetes sp. L.	Marigold	Amarillo	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Fruitfly (*Drosophila melanogaster* Meigen)	Naturalized	Local vegetable farmers from Bukidnon, South Cotabato, Davao City and Compostella Valley	Region X (Northern Mindanao), Region XII (SOCCSKSARGEN), Region XI (Davao Region)	(Concepcion et al., 2011)
	Tagetes sp. L.	Marigold	Amarillo	Flowers	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Naturalized	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Tithonia diversifolia (Hemsl.) A.Gray	Wild Sunflower		Whole plant	Not extracted	Inter-cropping	Insect pests	Naturalized	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
Basellaceae	*Basella alba* L.	Malabar spinach	Bahushus, Alugbati	Whole plant	Aqueous extraction (water)	Direct spray on crops	Insect pests	Native	Isnag/Apayao People	CAR	(Angagan et al., 2010)
Boraginaceae	*Heliotropium indicum* L.	Indian Turnsole	Ulad-ulad	Leaves, stems	Fresh direct application	Topical application	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Cannaceae	*Canna indica* L.	Indian Shot	Tagunsay	Leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Caricaceae	*Carica papaya* L.	Papaya	Papaya	Leaves	Air dried	Topical application, burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)

Convolvulaceae	*Ipomoea aquatica* Forssk.	Water spinach	Kangkong	Leaves, stems	Aqueous extraction (water)	Not specified	Insect pests	Native	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)
	Ipomoea aquatica Forssk.	Water spinach	Kangkong	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests (rice, vegetables)	Native	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
	Ipomoea triloba Thunb.	Three-lobe morning glory	Magkakamote/ Magkakamutsi	Not specified	Not specified	Not specified	Insect pests	Naturalized	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
Coriariaceae	*Coriaria intermedia* Matsum.	Japanese false blueberry	Baket	Not specified	Not specified	Not specified	Insect pests	Native	Kalanguya People	CAR	(Balangcod & Balangcod, 2009)
Cucurbitaceae	*Momordica charantia* L.	Bitter melon	Ampalaya	Whole plant	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Cyperaceae	*Cyperus cyperoides* (L.) Kuntze	Sedge	Muta	Whole plant	Mechanical extraction, boiling	Direct spray on crops	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	Obico and Ragragio (2014)
Dioscoreaceae	*Dioscorea hispida* Dennst.	Indian three-leaved yam	Nami	Tubers	Aqueous extraction (water, detergent/soap and kerosene)	Direct spray on insect, direct spray on crops, direct spray in the field	Insect pests (okra)	Native	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
Euphorbiaceae	*Croton tiglium* L.	Purging Croton	Tuba	Leaves	Aqueous extraction (water, detergent/soap and kerosene)	Direct spray on insect, direct spray on crops, direct spray in the field	Insect pests (rice)	Native	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
	Euphorbia hirta L.	Euphorbia	Malabuntes	Leaves	Air dried, mechanical extraction	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Euphorbia neriifolia L.	Indian spurgetree	Soro-soro	Stems	Aqueous extraction (detergent/soaps, water)	Immersion, direct spray on crops	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius)	Cultivated	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Euphorbia tirucalli L.	Pencil cactus	Pobreng Kahoy	Stems	Aqueous extraction (detergent/soaps, water)	Immersion, direct spray on crops	Worm maggots	Cultivated	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Homalanthus fastuosus (Linden) Fern.-Vill.	Buta	Buta	Not specified	Not specified	Not specified	Insect pests	Native	Ifugao People	CAR	(Taguiling, 2013)
	Manihot esculenta Crantz	Cassava	Kamoteng Kahoy	Root, leaves	Not specified	Not specified	Insect pests	Naturalized	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Croton colubrinoides Merr.	Tukbo	Tukbo	Not specified	Not specified	Not specified	Insect pests	Native	Ifugao People	CAR	(Taguiling, 2013)
	Jatropha curcas L.	Physic nut	Tubang-bakod	Roots, leaves	Not specified	Not specified	Insect pests	Cultivated	Chavacano, Visayan, Tausug, Bajau, Sama, Yakan, Subanen, and Subanon ethnolinguistic groups in Zamboanga Peninsula	Region IX (Zamboanga Peninsula)	(Madjos & Ramos, 2021)
	Jatropha curcas L.	Physic nut	Tubang-bakod	Fruits, leaves, roots	Fermentation, mechanical extraction	Direct spray on crops, direct spray in the field	Pod borers (*Maruca vitrata* Fabricius)	Cultivated	Ifugao People	CAR	(Allig, 2017)
	Jatropha curcas L.	Physic nut	Tubang-bakod	Roots, leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Cultivated	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
Fabaceae	*Derris trifoliata* Lour.	Common Derris	Tuba-tuba	Leaves, barks, stems	Aqueous extraction (detergent/soap and kerosene)	Direct spray on insect, spray on crops	Insect pests (rice)	Native	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
	Derris trifoliata Lour.	Common Derris	Tuba-tuba	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests (rice, vegetables)	Native	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
	Acacia auriculiformis A. Cunn. ex Benth.	Eucalyptus	Eucalyptus	Leaves	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)

Acacia auriculiformis A. Cunn. ex Benth.	Eucalyptus	Eucalyptus	Not specified	Not specified	Not specified	Insect pests	Naturalized	Ayta People	Region III (Central Luzon)	(Agduma et al., 2011)
Piliostigma malabaricum (Roxb.) Benth.	Bauhinia	Kalibangbang	Not specified	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Cajanus cajan (L.) Huth	Pigeon pea	Kadyos	Leaves	Mechanical extraction	Topical application, burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Roots	Aqueous extraction (water)	Direct spray on crops	Insect pests	Native	Alangan Mangyan People	MIMAROPA	Villanueva and Buot (2020)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Whole plant, roots	Mechanical extraction, aqueous extraction (detergent/soaps, water), soaking	Direct spray on crops, direct spray in the field, burning, immersion	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius), Green locust (*Phymateus viridipes* Stål), Leaf hopper (Cicadellidae), Worms	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Whole plant	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Native	Local farmers of Mt. Banahaw, Sierra Madre Range	Region IV-A (CALABARZON)	(Fujisaka, 1986)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Not specified	Combination and fermentation	Direct spray on crops (jackfruit)	Insect pests (Jackfruit)	Native	Local farmers of Brgy. Linao, Inopacan, Leyte	Region VIII (Eastern Visayas)	(Salomon et al., 2014)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Leaves	Fermentation, mechanical extraction	Not specified	Insect pests	Native	Local community of agroforest in Makilala, North Cotabato, Philippines	Region XII (SOCCSKSARGEN)	(Agduma et al., 2011)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Whole plant	Boiling	Topical application	Mosquito	Native	Matigsalug People	Region XI (Davao Region)	(Gascon, 2011)
Derris elliptica (Wall.) Benth.	Poison Vine	Tubli	Not specified	Mechanical extraction	Not specified	Insect pests	Native	Local vegetable farmers from Bukidnon, South Cotabato, Davao City and Compostella Valley	Region X (Northern Mindanao), Region XII (SOCCSKSARGEN), Region XI (Davao Region)	(Concepcion et al., 2011)
Erythrina variegata L.	Indian coral tree	Dapdap	Leaves	Air dried	Broadcasting, burning	Black aphids (Aphididae)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Whole plant	Not extracted	Inter-cropping, trap cropping, olfactory repellency	Insect pests	Naturalized	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Whole plant	Not extracted	Inter-cropping	Insect pests	Naturalized	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Not specified	Aqueous extraction (detergent/soap, kerosene)	Direct spray on insect, direct spray on crops	Insect pests	Naturalized	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Leaves	Aqueous extraction (detergent/soaps, water)	Direct spray on crops, burning	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius, worm maggots	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakawate	Leaves, stems	Air dried, mechanical extraction	Burning, topical application	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Leaves	Aqueous extraction (water, detergent/soap)	Direct spray on crops	Aphids (Aphididae) and Leaf hopper (Cicadellidae)	Naturalized	Local Rice farmers of Bataan	Region III (Central Luzon)	(Abas, 2014)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Leaves	Air dried	Burning	Insect pests	Naturalized	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Not specified	Mechanical extraction	Topical application	Mosquito	Naturalized	Matigsalug People	Region XI (Davao Region)	(Gascon, 2011)
Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Not specified	Aqueous extraction (water)	Not specified	Insect pests	Naturalized	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)

	Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Leaves, stems	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Naturalized	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Gliricidia sepium (Jacq.) Kunth	Madre de cacao	Kakwate	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests (rice, vegetables)	Naturalized	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
	Leucaena leucocephala (Lam.) de Wit	Leucaena	Ipil-ipil	Leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Parkia timoriana (DC.) Merr.	Timor tree	Kupang	Fruits	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Phaseolus lunatus L.	Lima bean	Patani	Whole plant, leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Phyllodium pulchellum (L.) Desv.	Phyllodium	Kupit	Whole plant, leaves, stems	Air dried	Burning, household repellence	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Pithecellobium dulce (Roxb.) Benth.	Manila tamarind	Kamatsiles	Stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Pongamia pinnata (L.) Pierre	Pongame oiltree	Bani	Leaves, branches	Aqueous extraction (detergent/soaps, water), air dried	Direct spray on crops, burning	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Senna alata (L.) Roxb.	Ringworm bush	Akapulko	Leaves	Mechanical extraction	Topical application	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Lamiaceae	*Ocimum tenuiflorum* L.	Holy Basil	Sulasi	Whole plant	Not extracted	Inter-cropping	Insect pests	Native	Local farmers of Cabuyao, Laguna	Region IV-A (CALABARZON)	(Rivera, 2015)
	Coleus scutellarioides (L.) Benth.	Coleus	Mayana	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Native	Local Upland Farmers of Aklan	Region VI (Western Visayas)	(Arangote, 2018)
	Gmelina arborea Roxb. ex Sm.	Beechwood	Molina	Leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Mentha arvensis L.	Spearmint	Yerbabuena	Whole plant	Aqueous extraction (water)	Direct spray on crops	Insect pests	Native	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
	Mentha arvensis L	Spearmint	Yerbabuena	Not specified	Mechanical extraction	Direct spray on crops	Insect pests	Native	Maranao Farmers	BARMM	(Valdez, 2023)
	Mentha spicata L.	Spearmint	Yerbabuena	Whole plant	Not extracted	Inter-cropping	Insect pests	Naturalized	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
	Origanum vulgare L.	Oregano	Sugada	Whole plant	Aqueous extraction (water)	Direct spray on crops	Insect pests	Introduced (Non-native)	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
	Origanum vulgare L.	Oregano	Sugada	Whole plant	Not extracted	Inter-cropping	Insect pests	Cultivated	Local farmers of Cabuyao, Laguna	Region IV-A (CALABARZON)	(Rivera, 2015)
	Origanum vulgare L.	Oregano	Sugada	Not specified	Mechanical extraction	Direct spray on crops	Insect pests	Introduced (Non-native)	Maranao Farmers	BARMM	(Valdez, 2023)
	Origanum vulgare L.	Oregano	Sugada	Whole plant	Not extracted	Inter-cropping	Insect pests	Introduced (Non-native)	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
	Origanum vulgare L.	Oregano	Sugada	Whole plant, leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Introduced (Non-native)	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Premna odorata Blanco	Fragrant Premna	Alagao	Leaves	Mechanical extraction	Direct spray on crops, direct spray in the field	Leaf folder (*Cnaphalocrocis medinalis* Guenée), Armyworms (Noctuidae), Stemborers	Native	Ifugao People	CAR	(Allig, 2017)
	Vitex negundo L.	Lagundi	Lagundi	Leaves	Air dried, mechanical extraction	Burning, topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
	Vitex negundo L.	Lagundi	Lagundi	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Native	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Vitex parviflora A. Juss.	Molave Tree	Tugas	Leaves, stems	Air dried	Burning, topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
Lauraceae	*Camphora* sp.	Camphor		Not specified	Aqueous extraction (detergent/soap, kerosene)	Direct spray on insect, direct spray on crops	Insect pests	Cultivated	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)

Loganiaceae	*Strychnos ignatii* P.J.Bergius	Igasud	St. Ignatius tr ee	Leaves, barks	Aqueous extraction (water, detergent/soap and kerosene)	Direct spray on insect, direct spray on crops	Insect pests (rice)	Native	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
Lythraceae	*Lagerstroemia speciosa* (L.) Pers.	Pride of India	Banaba	Leaves	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Native	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
Malvaceae	*Hibiscus* sp. L.	Gumamela	Gumamela	Whole plant	Aqueous extraction (water, vinegar)	Direct spray on crops	Insect pests	Naturalized	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
	Hibiscus sp. L.	Hibiscus	Gumamela	Not specified	Mechanical extraction	Direct spray on crops	Insect pests	Native	Maranao Farmers	BARMM	(Valdez, 2023)
	Sida acuta Burm.f.	Sida	Alyabon	Leaves, stems	Air dried	Burning, household repellence	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
	Sida acuta Burm.f.	Sida	Alyabon	Leaves, stems	Air dried	Drink the decoction	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
Marattiaceae	*Marattia* sp. Sw.	Dwarf thornless fern		Leaves, stems	Mechanical extraction	Direct spray on crops, direct spray on insect, direct spray in the field	Leaf folder (*Cnaphalocrocis medinalis* Guenée), Armyworms (Noctuidae)	Native	Ifugao People	CAR	(Allig, 2017)
Meliaceae	*Azadirachta indica* A.Juss.	Neem	Balunga	Leaves	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Azadirachta indica A.Juss.	Neem	Balunga	Leaves, barks, stems	Aqueous extraction (water, detergent/soap and kerosene)	Direct spray on insect, direct spray on crops	Insect pests (rice)	Naturalized	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
	Azadirachta indica A.Juss.	Neem	Balunga	Leaves	Aqueous extraction (water, detergent/soap)	Direct spray on crops, direct spray on insect	Aphids (Aphididae) and Leaf hopper (Cicadellidae)	Naturalized	Local Rice farmers of Bataan	Region III (Central Luzon)	(Abas, 2014)
	Azadirachta indica A.Juss.	Neem	Balunga	Seeds, leaves, barks	Fermentation, mechanical extraction	Direct spray on crops, direct spray on insect	Insect pests	Naturalized	Vegetable farmers of Cagayan Valley Region, Northern Philippines	Region II (Cagayan Valley)	(Conrado & Antonio, 2016)
	Azadirachta indica A.Juss.	Neem	Balunga	Not specified	Not specified	Not specified	Insect pests	Naturalized	Ayta People	Region III (Central Luzon)	(Agduma et al., 2011)
	Azadirachta indica A.Juss.	Neem	Balunga	Not specified	Aqueous extraction (water)	Not specified	Insect pests	Naturalized	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)
	Azadirachta indica A.Juss.	Neem	Balunga	Leaves	Fermentation, mechanical extraction	Direct spray on crops, direct spray on insect	Insect pests	Naturalized	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Sandoricum koetjape (Burm.f.) Merr.	Cotton fruit	Santol	Leaves	Mechanical extraction	Topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Sandoricum koetjape (Burm.f.) Merr.	Cotton fruit	Malasantol	Not specified	Not specified	Not specified	Insect pests	Native	Ifugao People	CAR	(Taguiling, 2013)
	Swietenia macrophylla King	Mahogany	Mahogany	Fruits (exocarp)	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
Menispermaceae	*Anamirta cocculus* (L.) Wight & Arn., 1834	Indian Berry	Bayati	Seeds	Aqueous extraction (water)	Direct spray on crops	Insect pests	Native	Alangan Mangyan People	MIMAROPA	(Villanueva & Buot, 2020)
	Anamirta cocculus (L.) Wight & Arn., 1834	Indian Berry	Lagtang	Leaves, fruits	Mechanical extraction, aqueous extraction (detergent/soaps, water), soaking	Direct spray on crops, direct spray on insect, burning	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius), Green locust (*Phymateus viridipes* Stål), Leaf hopper (Cicadellidae), Worms	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Anamirta cocculus (L.) Wight & Arn., 1834	Indian Berry	Bayati	Leaves	Mechanical extraction	Not specified	Insect pests	Native	Local community of agroforest in Makilala, North Cotabato, Philippines	Region XII (SOCCSKSARGEN)	(Agduma et al., 2011)
	Arcangelisia flava (L.) Merr.	Arcangelisia	Suma	Leaves	Air dried, mechanical extraction	Topical application	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio 2014)
	Tinospora crispa (L.) Hook.f. & Thomson	Heavenly elixir	Makabuhay	Leaves	Fresh direct application	Preventative storage technique	Rice Weevil (*Sitophilus oryzae* Linnaeus, 1763)	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)

	Tinospora crispa (L.) Hook.f. & Thomson	Heavenly elixir	Makabuhay	Stems	Aqueous extraction (water, detergent/soap)	Direct spray on crops	Aphids (Aphididae) and Leaf hopper (Cicadellidae)	Naturalized	Local Rice farmers of Bataan	Region III (Central Luzon)	(Abas, 2014)
	Tinospora crispa (L.) Hook.f. & Thomson	Heavenly elixir	Makabuhay	Not specified	Combination and fermentation	Direct spray on crops (jackfruit)	Insect pests (Jackfruit)	Naturalized	Local farmers of Brgy. Linao, Inopacan, Leyte	Region VIII (Eastern Visayas)	(Salomon et al., 2014)
	Tinospora crispa (L.) Hook.f. & Thomson	Heavenly elixir	Makabuhay	Leaves, stems	Fermentation, mechanical extraction	Direct spray on crops	Insect pests (rice, vegetables), Corn borers (*Ostrinia nubilalis* Hübner)	Naturalized	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
Moraceae	*Artocarpus blancoi* (Elmer) Merr.	Antipolo	Tipolo	Leaves	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Ragragio et al., 2013)
	Artocarpus blancoi (Elmer) Merr.	Antipolo	Tipolo	Leaves	Not specified	Not specified	Insect pests	Native	Ayta People	Region III (Central Luzon)	(Agduma et al., 2011)
	Artocarpus heterophyllus Lam.	Jackfruit	Langka	Leaves	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Ficus minahassae (de Vriese & Teijsm.) Miq.	Hagimit	Aymit	Stems	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Ficus nota (Blanco) Merr.	Sacking tree	Tibig	Stems	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Ficus pseudopalma Blanco	Philippine Fig	Bangaba	Leaves, stems	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Ficus sp. L.	Fig tree	Kadota	Barks	Mechanical extraction	Direct spray on crops, direct spray in the field	Leaf folder (*Cnaphalocrocis medinalis* Guenée), Armyworms (Noctuidae)	Cultivated	Ifugao People	CAR	(Allig, 2017)
	Ficus ulmifolia Lam.	Scouring Leaf	Gih-gih	Leaves, stems	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Moringaceae	*Moringa oleifera* Lam.	Moringa	Malunggay	Leaves	Not extracted	Preventative storage technique	Rice Weevil (*Sitophilus oryzae* Linnaeus, 1763)	Cultivated	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Moringa oleifera Lam.	Moringa	Malunggay	Leaves	Mechanical extraction	Burning, topical application, drink the decoction	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Musaceae	*Musa x paradisiaca* L.	Banana	Saging	Leaves	Air dried, mechanical extraction	Burning, direct spray on insect	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Myrtaceae	*Eucalyptus* sp. L'Hér.	Eucalyptus	Kaliptus	Leaves	Air dried, mechanical extraction	Burning, direct spray on insect	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Psidium guajava L.	Guava	Bayabas	Leaves, stems	Air dried	Burning, drink the decoction	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Oleaceae	*Tetrapilus borneensis* (Boerl.) de Juana	Kurutan	Kurutan	Not specified	Not specified	Not specified	Insect pests	Native	Ifugao People	CAR	(Taguiling, 2013)
Passifloraceae	*Passiflora foetida* L.	Passionfruit	Wakay dagis	Leaves	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Piperaceae	*Piper betle* L.	Betel	Ikmo	Leaves	Mechanical extraction	Direct spray on crops	Insect pests	Cryptogenic	Maranao Farmers	BARMM	(Valdez, 2023)
	Piper betle L.	Betel	Ikmo	Leaves	Air dried	Burning	Insect pests	Cryptogenic	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
Pittosporaceae	*Pittosporum pentandrum* (Blanco) Merr	Taiwanese cheesewood	Mamalis	Leaves	Aqueous extraction (detergent/soaps, water)	Direct spray on insect, spray on crops	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
Poaceae	*Cymbopogon citratus* (DC.) Stapf	Lemon Grass	Tanglad	Whole plant	Not extracted	Inter-cropping, trap cropping	Insect pests	Cultivated	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Whole plant	Not extracted	Inter-cropping	Insect pests	Cultivated	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Leaves	Aqueous extraction (detergent/soap)	Direct spray on insect	Insect pests	Cultivated	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Cymbopogon citratus (DC.) Stapf	Lemongrass	Tanglad	Leaves, stems	Air dried, essential oil extraction	Burning, topical application	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)

	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Whole plant	Not extracted	Inter-cropping	Insect pests	Cultivated	Maranao Farmers	BARMM	(Valdez, 2023)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Stems	Fresh direct application	Grain exposure method	Rice Weevil (*Sitophilus oryzae* Linnaeus, 1763)	Cultivated	Local farmers of Albay Province, Philippines	Region V (Bicol Region)	(Narvaez, 2019)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Leaves	Mechanical extraction	Burning, topical application	Mosquito	Cultivated	Matigsalug People	Region XI (Davao Region)	(Gascon, 2011)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Cultivated	Local Upland Farmers of Aklan	Region VI (Western Visayas)	(Arangote, 2018)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests (rice)	Cultivated	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Mendez et al., 2021)
	Cymbopogon citratus (DC.) Stapf	Lemon Grass	Tanglad	Leaves, stems	Fermentation, mechanical extraction	Direct spray on crops, direct spray on insect	Insect pests	Cultivated	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Cymbopogon nardus (L.) Rendle	Citronella Grass		Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Native	Banana farmers	Region XII (SOCCSKSARGEN)	(Aguilar et al., 2014)
	Cymbopogon nardus (L.) Rendle	Citronella Grass		Leaves, stems	Fermentation, mechanical extraction	Direct spray on crops	Insect pests	Native	Local farmers of Malvar, Batangas Province	Region IV-A (CALABARZON)	(Villegas et al., 2014)
	Eleusine indica (L.) Gaertn.	Haygrass	Hayapaw	Leaves, roots	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Polygalaceae	*Xanthophyllum flavescens* Roxb.	Yellow wood	Balugbog	Leaves	Not extracted	Preventative storage technique	Rice Weevil (*Sitophilus oryzae* Linnaeus, 1763)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	Alburo and Olofson (1987)
Polypodiaceae	*Selliguea taeniata* (Sw.) Parris		Ag-agfa	Leaves	Mechanical extraction, soaking	Direct spray on crops, direct spray in the field	Cutworms, Armyworms (Noctuidae)	Native	Ifugao People	CAR	(Allig, 2017)
Rutaceae	*Citrus × microcarpa* Bunge	Philippine lime	Kalamansi	Leaves	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Lunasia amara Blanco	Lunasia	Lunas	Leaves	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Murraya paniculata (L.) Jack	orange jasmine	Kamuning	Stems	Air dried	Burning	Hematophagous insects	Native	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Sapotaceae	*Chrysophyllum cainito* L.	Star apple	Kaimito	Leaves	Air dried	Burning	Hematophagous insects	Cultivated	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
Solanaceae	*Capsicum annuum* L.	Hot Chili Pepper	Siling pula	Whole plant	Not extracted	Inter-cropping	Insect pests	Cultivated	Local farmers of Cabuyao, Laguna	Region IV-A (CALABARZON)	(Rivera, 2015)
	Capsicum annuum L.	Hot Chili Pepper	Siling pula	Not specified	Not specified	Not specified	Insect pests	Cultivated	Chili pepper farmers of Cebu Islands	Region VII (Central Visayas)	(Casio et al., 2021)
	Capsicum annuum L.	Hot Chili Pepper	Siling pula	Fruits	Fermentation and aqueous extraction (vinegar)	Direct spray on crops	Insect pests (rice, vegetables)	Cultivated	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
	Capsicum frutescens L.	Chili	Siling labuyo	Fruits	Aqueous extraction (detergent/soaps, water)	Direct spray on crops, burning	Rice bug (*Leptocorisa acuta* Thunberg), Black bug (*Scotinophara coarctata* Fabricius), Green locust (*Phymateus viridipes* Stål), Leaf hopper (Cicadellidae), worms	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Capsicum frutescens L.	Chili	Siling labuyo	Fruits	Aqueous extraction (water, detergent/soap and kerosene)	Direct spray on insect, spray on crops	Insect pests (rice)	Naturalized	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
	Capsicum frutescens L.	Chili	Siling labuyo	Not specified	Mechanical extraction	Direct spray on crops	Fruitfly (*Drosophila melanogaster* Meigen)	Naturalized	Local farmers of Ilocos Norte	Region I (Ilocos Region)	(Lutap & Atis, 2014)
	Capsicum frutescens L.	Chili	Siling labuyo	Not specified	Aqueous extraction (water)	Not specified	Insect pests	Naturalized	Chili pepper farmers of Cebu Islands	Region VII (Central Visayas)	(Casio et al., 2021)
	Capsicum frutescens L.	Chili	Siling labuyo	Fruits	Aqueous extraction (water)	Not specified	Insect pests	Naturalized	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)
	Capsicum sp. L.	Chili	Sili	Whole plant, fruits	Aqueous extraction (water)	Direct spray on crops	Insect pests	Naturalized	Local rice farmers of Camarines Sur	Region V (Bicol Region)	(Nicolas & Cabarogias, 2015)

	Capsicum sp. L.	Chili	Sili	Fruits	Aqueous extraction (water)	Direct spray on crops	Insect pests	Naturalized	Organic rice farmers in Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2021)
	Capsicum sp. L.	Chili	Sili	Fruits	Aqueous extraction (detergent/soap)	Direct spray on insect, spray on crops	Insect pests	Naturalized	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Capsicum sp. L.	Chili	Sili	Fruits	Aqueous extraction (water), mechanical extraction	Direct spray on crops	Insect pests	Cultivated	Maranao Farmers	BARMM	(Valdez, 2023)
	Datura metel L.	Asthma weed	Tawa-tawa	Whole plant	Mechanical extraction, fermentation	Direct spray on crops, direct spray in the field	Armyworms, Cutworms (Noctuidae), Stemborers	Naturalized	Ifugao People	CAR	(Allig, 2017)
	Nicotiana tabacum L.	Tobacco	Tabako	Leaves	Aqueous extraction (detergent/soaps, water)	Direct spray on crops	Insect pests	Naturalized	Alangan Mangyan People	MIMAROPA	(Villanueva & Buot, 2020)
	Nicotiana tabacum L.	Tobacco	Tabako	Stems	Aqueous extraction (detergent/soaps, water)	Direct spray on insect, direct spray on crops	Rice bug (*Leptocorisa acuta* Thunberg)	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
	Nicotiana tabacum L.	Tobacco	Tabako	Leaves	Aqueous extraction (water, detergent/ soap and kerosene)	Direct spray on insect, direct spray on crops	Insect pests (rice)	Naturalized	Local Rice farmers of Northern Samar	Region VIII (Eastern Visayas)	(Tuan, 2019)
	Nicotiana tabacum L.	Tobacco	Tabako	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Naturalized	Local Upland Farmers of Aklan	Region VI (Western Visayas)	(Arangote, 2018)
	Nicotiana tabacum L.	Tobacco	Tabako	Leaves	Fermentation and aqueous extraction (vinegar)	Direct spray on crops	Insect pests (rice, vegetables)	Naturalized	Local rice and vegetable farmers of Cavite, Laguna, Batangas Quezon and Rizal	Region IV-A (CALABARZON)	(Villegas-Pangga, 2013)
	Solanum donianum Walp.	Mullein nightshade	Malatalong	Leaves, stems	Mechanical extraction	Direct spray on crops, direct spray in the field	Leaf folder (*Cnaphalocrocis medinalis* Guenée), Armyworms (Noctuidae), Maggots (Diptera), and Stem borers (*Chilo suppressalis* Walker, 1863)	Naturalized	Ifugao People	CAR	(Allig, 2017)
Thymelaeaceae	*Wikstroemia indica* (L.) C.A. Mey.	Indian stringbush	Salago	Leaves	Air dried	Direct spray on crops, burning	Rice bug (*Leptocorisa acuta* Thunberg), black bug (*Scotinophara coarctata* Fabricius)	Native	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)
Verbenaceae	*Lantana camara* L.	Lantana	Lantana	Leaves, stems	Air dried	Burning	Hematophagous insects	Naturalized	Ayta People	Region III (Central Luzon)	(Obico & Ragragio, 2014)
	Lantana camara L.	Lantana	Lantana	Not specified	Mechanical extraction	Direct spray on crops	Fruitfly (*Drosophila melanogaster* Meigen)	Naturalized	Local farmers of Ilocos Norte	Region I (Ilocos Region)	(Lutap & Atis, 2014)
Zingiberaceae	*Zingiber officinale* Roscoe	Ginger	Luya	Rhizomes	Aqueous extraction (detergent/soap)	Direct spray on insect, spray on crops	Insect pests	Naturalized	Local farmers of Rizal Province and Laguna Province, Local farmers from Panay Islands, Iloilo Province, Local farmers from Bukidnon Province	Region IV-A (CALABARZON), Region VI (Western Visayas), Region X (Northern Mindanao)	(Horgan et al., 2023)
	Zingiber officinale Roscoe	Ginger	Luya	Rhizomes	Fermentation, mechanical extraction	Direct spray on crops	Crawling insects	Naturalized	Vegetable farmers of Cagayan Valley Region, Northern Philippines	Region II (Cagayan Valley)	(Conrado & Antonio, 2016)
	Zingiber officinale Roscoe	Ginger	Luya	Whole plant	Not extracted	Inter-cropping, aromatic repellency	Insect pests	Naturalized	Local Upland Farmers of Aklan	Region VI (Western Visayas)	(Arangote, 2018)
	Zingiber officinale Roscoe	Ginger	Luya	Rhizomes	Aqueous extraction (water)	Not specified	Insect pests	Naturalized	Local rice farmers of Nueva Vizcaya	Region II (Cagayan Valley)	(Galvez, 2017)
Zosteraceae	*Zostera* spp. L.	Seagrass	Lusay	Leaves	Fermentation	Staking	Insect pests	Naturalized	Wet rice and corn farmers in Argao, Cebu Islands, Philippines	Region VII (Central Visayas)	(Alburo & Olofson, 1987)

Most Asteraceae species synthesize Essential oils (EOs) containing terpenoids which have been widely explored and preferred in organic farming due to low toxicity and no food residues (Matos & Cunha, 2023). Moreover, diverse aromatic species within the Lamiaceae family, which includes 236 genera and 7,000 species, have high pesticide potential known for their ability to produce essential oils which are pollinators and pests' antagonists' attractants (Ebadollahi et al., 2020). Lamiaceae species produce bioactive terpenes (monoterpenoid) and phenylpropanoids which cause acute toxicity, repellency, antifeedant, and multiple insecticidal modes of action (Marchioni et al., 2020). This makes them safe, accessible, and effective alternatives to synthetic pesticides. Euphorbiaceae and Solanaceae were also reported to have widespread use as botanical insecticides. Most species belonging to Euphorbiaceae are perennial herbs and weeds that have allelopathic effects, high phytotoxicity and potential insecticidal activities (Dastagir & Hussain, 2013; Tanveer et al., 2013). This is due to high levels of phenolics, flavonoids, diterpenes, terpenoids, and tannins causing up to 40% insect mortality (Dastagir & Hussain, 2013). However, finding a balance between the insecticidal application of Euphorbiaceae species and its potential inhibitory effects on seed germination, seedling growth, and crop yield remains a challenge. It is interesting that Solanaceae family has the highest species variation and reports of insecticidal plants in the Philippines. Solanaceae species have been traditionally used and have observed steroidal alkaloids and saponins, disaccharides, flavonoids, and phenols that promote biocidal, insecticidal and larvicidal activities (Chowański et al., 2016; Chidambaram et al., 2022). Although well-documented, there is a need for controlled studies to assess validity of traditional applications in terms of efficacy, safety, and chemical variability to ensure sustainability and prevent overexploitation.

Of the 91 genera, the genus *Ficus* (Spc: 5 counts, 4.46%) has the highest number of species, followed by genus *Allium*, *Capsicum*, *Euphorbia*, and *Tagetes* (Spc: 3 counts each, 2.68%) (Fig. 6). Among the 199 reports, the genera *Capsicum* and *Cymbopogon* were the most reported (12 counts, 6.03%). Subsequently, the genus *Derris* (9 counts, 4.52%), *Tagetes* (7 counts, 3.52%), and *Allium* (6 counts, 3.02%) lead the highest number of reports. *Capsicum* and *Cymbopogon* species highest report frequency is likely due to its wide usage in culinary aspect, often grown as cash crops in farms. Although the genus *Capsicum* has relatively few species, with approximately 25 recognized, it is still widely used by farmers due to its high content of capsaicin, capsaicinoids, carotenoids, tannins, alakaloids, steroids, glycosides, phenolic compounds, and flavonoids such as quercetin and luteolin which act as irritants and toxic to insects (Vinayaka et al., 2010; Swamy, 2023). *Cymbopogon* spp. have established essential oil insect fumigant, antifeedant, and repellent activities caused by bioactive compounds such as citronellal, citronellol, eugenol and limonene (Hernandez-Lambraño et al., 2015). Interestingly, the genus *Ficus* has the highest species variety but has fewer reports in comparison to *Capsicum* and *Cymbopogon*. The broad diversity but low report frequency suggest that *Ficus* species are less recognized in local and ethnobotanical pest control as most of the 900 species of trees, shrubs, and vines are known for their traditional medicine and ornamental purposes (Salehi et al., 2021). Cultural knowledge and familiarity, practical use, and economic importance may influence the selection of botanical insecticides in traditional farming communities.

Madre de Cacao (*Gliricidia sepium*), locally known as *Kakawate*, was the most frequently reported species (11 counts, 5.5%) under the family Fabaceae (Fig. 7). This was followed closely by Lemon Grass (*Cymbopogon citratus*) (10 counts, 5%), locally called *Tanglad* of Poaceae family. Neem, *Balunga* (*Azadirachta indica*) (7 counts, 3.5%) under Meliaceae, Poison Vine, *Tubli* (*Derris elliptica*) (7 counts, 3.5%) under Fabaceae. *Gliricidia sepium* is likely frequently reported as it is a fast-growing invasive species in the Philippines, found as colonizer in disturbed sites and near farming areas (Rojas-Sandoval, 2017). Due to its widely introduced status, this species is also well studied in ethnopharmacology, used as antioxidant, antifungal, anti-inflammatory, antimicrobial, acaricidal, and insect-repellent due to its high levels of alkaloids, flavonoids, and cardiac glycosides (Alade et al., 2021; Nison & Shrikumar, 2023).

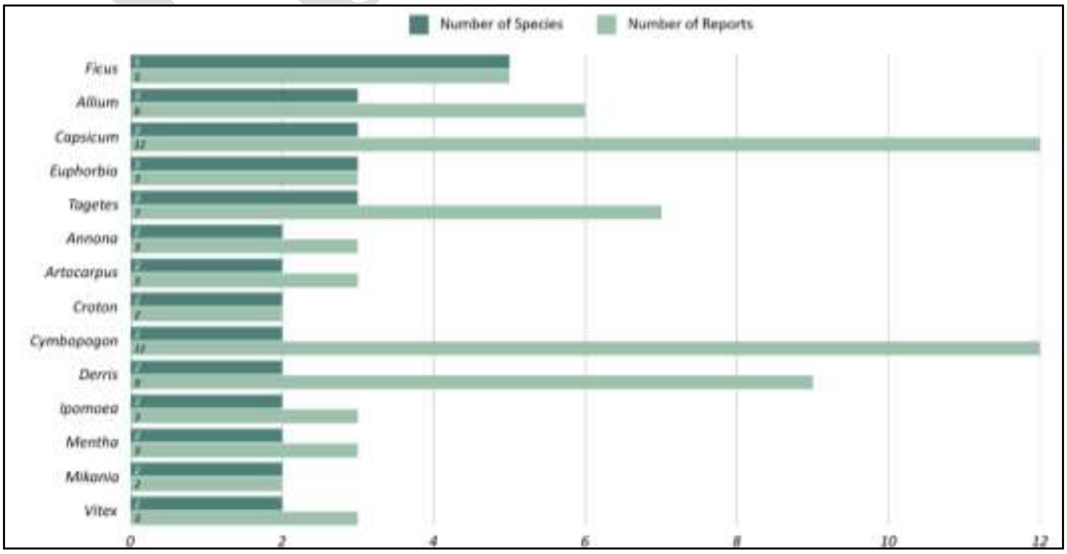

Fig. 6: Fourteen traditionally used plant genera with the highest number of species.

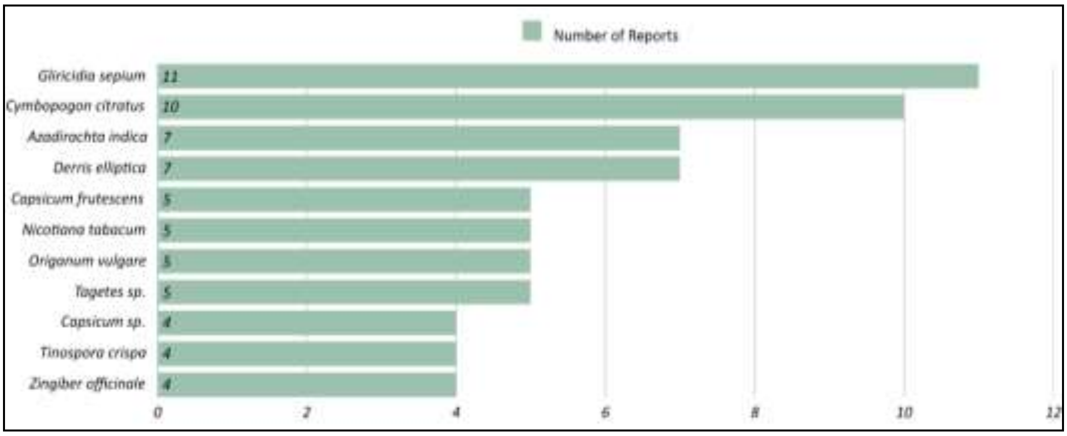

Fig. 7: Eleven traditionally used insecticidal plant species with the highest number of reports.

Leaf extracts are scientifically proven to be effective against various insect pests, while simultaneously enhance yield, preserve beneficial insects, and did not alter taste and odor of crops (Kamanga et al., 2025). Several plants listed are well-documented for their pesticidal properties, including *Cymbopogon citratus* (lemongrass), *Azadirachta indica* (neem), *Derris elliptica* (tubli), *Capsicum frutescens* (chili pepper), *Nicotiana tabacum* (tobacco), *Origanum vulgare* (Oregano), *Tagetes* sp. (marigold), *Tinospora rumphii* (makabuhay), *Zingiber officinale* (ginger), *Allium sativum* (garlic), and *Pongamia pinnata* (karanja tree). However, some species mentioned have limited insecticidal documentation, including *Coriaria intermedia*, *Selliguea taeniata*, *Homalanthus fastuosus*, and *Tetrapilus borneensis*. Underexplored species highlight the need for further studies on their bioactive compounds, field performance, and environmental impact.

The Philippines hosts diverse plant species, with 49 (43.4%) species native to the country, 47 (41.6%) are naturalized, 16 (14.2%) are cultivated and not naturalized, and 2 (1.8%) are cryptogenic species. The high number of native and naturalized plant species reflects the high ecological biodiversity of the country. Significantly, indigenous knowledge has played a crucial role in the selection and continued use of these native plants in many areas across the world, providing novel information in medicine, ecology, evolution, physiology, and climate change adaptation (Mbah et al., 2021; Jessen et al., 2022; Ssenku et al., 2022). Moreover, indigenous knowledge has also shaped sustainable pest management, promoting organic pest control through empirical observations, trial and error methods, and intergenerational knowledge. The diversity of naturalized plants is due to the long history of plant introduction, adaptability to tropical conditions, accessibility and affordability.

Extraction, Application and Mode of Action

The insecticidal plant parts used, their corresponding mode of extraction and application, and their mode of action to target insect pests are explored in this review. From a total of 248 reports, most of local and indigenous farming communities use leaves (101 counts, 40.7%) (Fig. 8a). This is followed by whole plant (43 counts, 17.3%), stems (36 counts, 14.5%), fruits (18 counts, 7.3%), roots and barks (6 counts each, 2.4%), bulbs (4 counts, 1.6%), rhizomes and seeds (3 counts each, 1.2%), flowers, tubers, and branches (1 count each, 0.4%), and not specified (25 counts, 10.1%). Insecticidal plants are extracted through 246 reports, primarily by mechanical extraction including pressing, grinding, crushing, or shredding the plant parts (59 counts, 24%), air dried and aqueous extraction (53 counts each, 21.5%), not extracted (28 counts, 11.4%), fermentation (27 counts, 11%), fresh direct application (4 counts, 1.6%), boiling, soaking, and essential oil extraction (3 counts, 1.2%), combination of two methods (2 counts, 0.8%), and not specified (14 counts, 5.7%) (Fig. 8b). Farmers specify the type of aqueous extraction they practice with 81 reports, including water (40 counts, 49.4%), detergent or soap (29 counts, 35.8%), kerosene (9 counts, 11.1%), and vinegar (3 counts, 3.7%) (Fig. 8c). Out of 267 reports, direct spray on infested crops (84 counts, 31.5%) was the most reported application method of insecticidal plants, followed by burning of dried parts (58 counts, 21.7%), inter-cropping near grown crops (26 counts, 9.7%), direct spray on insects (23 counts, 8.6%), topical application (18 counts, 6.7%), direct spray on the farm fields (14 counts, 5.2%), trap cropping (5 counts, 1.9%), using in household like hanging on the windows and scrubbing extracts on the floor, immersion where insects are submerged to plant extracts, drinking decoction to repel hematophagous insects that may harm humans, and preventative storage technique where plant parts are put near grain containers (3 counts each, 1.1%), grain exposure method where plant material is used to submerge grains to repel insects, guard planting where plants act as physical barrier, broadcasting that involves scattering plant material near the field and planted crops, and staking by using plants as physical support (1 count each, 0.4%), and not specified (23 counts, 8.6%) (Fig. 8d).

The prevalent use of leaves for botanical insecticide is due to their abundance and accessibility, as it is a readily harvested plant part. The year-round availability of leaves in tropical countries such as the Philippines makes leaf extraction practical and sustainable in comparison to other plant parts that require complex processing and potential damage to insecticidal plants. Although the concentration of bioactive compounds in plants varies on type of species, plant parts, and environmental factors, leaves are reported to contain high concentrations of secondary metabolites such as alkaloids, flavonoids, and tannins that have natural insecticidal properties (Gloria et al., 2023). It is interesting that indigenous farmers mainly resort to mechanical

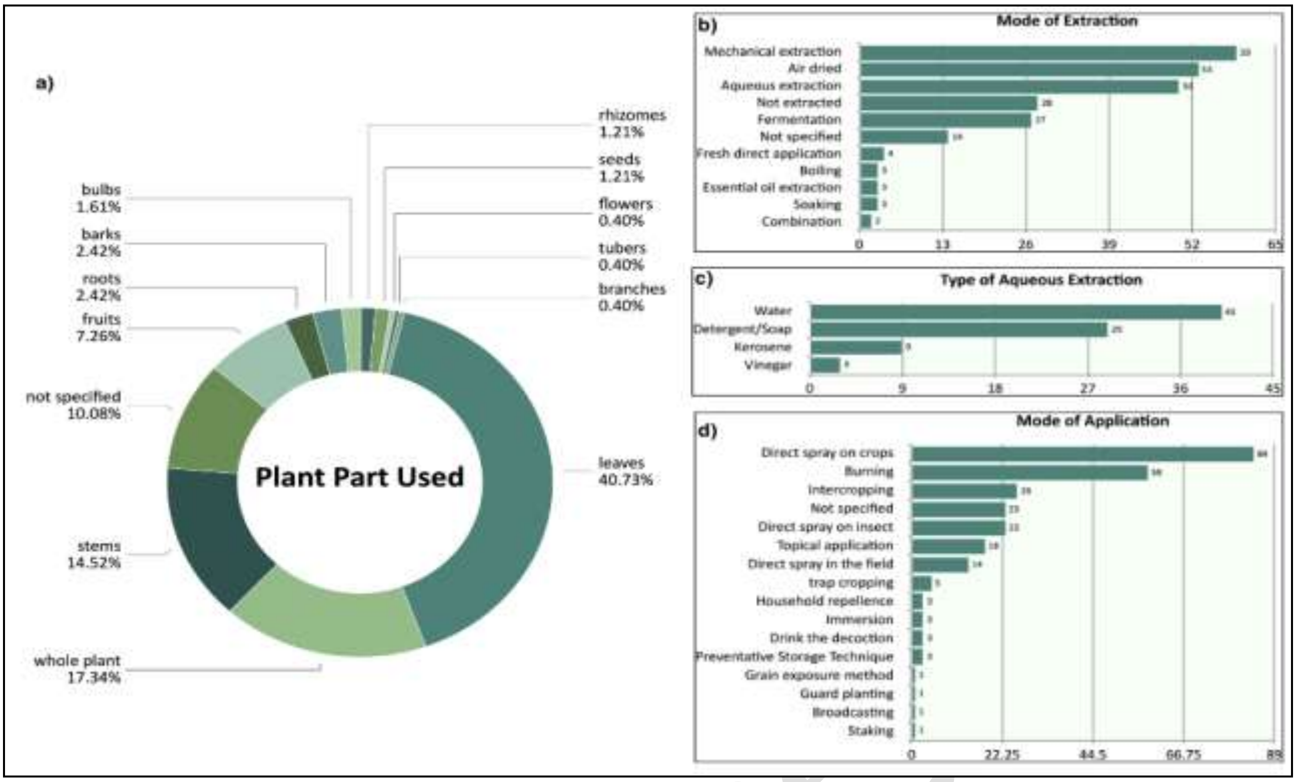

Fig. 8: Plant parts used (a), mode of extraction (b) and specific type of aqueous extraction (c), mode of application (d) of insecticidal plants used by ethnic groups and local farmers in the Philippines

extraction and air-drying, which are two very different approaches, as the preparation of raw material can affect phytochemical contents of final plant extracts (Krakowska-Sieprawska et al., 2022). Mechanical extraction is a collective term used in this study to describe the direct grinding, pressing and cold maceration of fresh plant parts. This is an ancient technique that requires few tools and can be done with basic materials like mortars, stones, or grinders. Scientific studies suggest that mechanical extraction has higher yield of heat-sensitive polar compounds such as phenolic compounds flavonoids and tannins (Che Sulaiman et al., 2017; Ramesh et al., 2024). Similarly, aqueous extraction where plant materials are boiled, soaked, and mixed with water, is also favored due to the ease of access of source and the simplicity of the process. Modified aqueous extraction using detergent, kerosene, and vinegar alters botanical insecticide efficacy by influencing polarity. Soap, acting as a surfactant, reduces surface tension and enhances the solubility and stability of non-polar bioactive compounds, similar to nanoemulsions (Campolo et al., 2020). Kerosene, a non-polar carrier, improves phytotoxicity in botanical sprays (Wale, 2004). Vinegar, with acetic acid as a polar solvent, aids in dissolving bioactive compounds, comparable to acetone (Abubakar et al., 2021). Consistent with the findings, crude and aqueous extracts have higher secondary metabolite yield and effectiveness than other extraction methods (Escobar-Garcia et al., 2024; Tomson et al., 2024; Verma & Singh, 2024). However, these extraction methods have lower efficiency for non-polar compounds such as fatty acids and triterpenes that may limit insecticide potency. Air drying, on the other hand, is a common extraction method involved in putting plant samples in shaded, airy places at ambient temperature over long periods of time to remove water content. Farmers commonly prefer air-drying plant materials because it is easy to prepare, and the dried materials can later be combined with burning during farm clearing. However, drying can cause modifications in plant composition, leading to loss of specific volatile bioactive compounds and affect the quality of plant extracts (Ramesh et al., 2024). In the case where plants are used for extraction, shade drying is ideal to retain important compounds for effective extraction. Once the plant is extracted, varying modes of application are employed by farmers. Primarily, direct spray on crops has the highest prevalence due to its easy, fast and large area coverage with minimal labor, increasing efficiency and observed effectiveness. This reasoning can also be used to account for why traditional farmers often burn dried plant materials to produce smoke that repels or kills insects. These methods are both time-efficient and readily accessible, making them well-suited for small-scale farmers with limited labor availability and financial resources. The high number of reports on intercropping reflects the role of cultural strategies in crop protection. Intercropping is a cultural practice in pest management where two or more crop species are grown in the same area to increase diversity, reduce insect pests' infestation, attract natural enemies and improve crop yield (Mir et al., 2022). In recent years, there has been growing interest in trap cropping, a form of intercropping in which specific plants are cultivated to divert pest attacks away from target crops, thereby reducing yield losses (Shelton & Badenes-Pérez, 2006). Although intercropping and trap cropping can reduce pest pressure and enhance biodiversity, their effectiveness depends on factors such as crop species, pest behavior, environmental conditions, and proper implementation, emphasizing the need for further research and site-specific optimization. The mentions of drinking decoction as a form of application refers to local belief that it can prevent infestations of hematophagous insects such as mosquitoes, ticks, lice, and mites that may feed on humans and livestock. However, research on the effectiveness of this practice remains limited.

Plant-insect Pest Network Analysis

To deepen the understanding of the relationship between insecticidal plant and specific insect pest, a network graph shows a distinct connection (Fig. 9). The three insect pests with the largest node sizes, rice bug, black bug, and armyworm, are the most frequently cited targets for insecticidal plant applications. Coincidentally, these insect pests are also identified as significant threat to staple crops such as corn and rice in the Philippines. Rice bug has the most reported plants used (11 counts, 14.7%), followed by black bug (10 counts, 13.5%), and armyworm (9 counts, 12.2%). Traditional control of rice bugs involves the use of plant parts from various species, including Indian Berry (*Anamirta cocculus*), Sugar Apple (*Annona squamosa*), Areca (*Areca catechu*), Chili (*Capsicum frutescens*), Poison Vine (*Derris elliptica*), Indian Spurgetree (*Euphorbia neriifolia*), Madre de Cacao (*Gliricidia sepium*), Tobacco (*Nicotiana tabacum*), Taiwanese Cheesewood (*Pittosporum pentandrum*), Pongame Oiltree (*Pongamia pinnata*), and Indian Stringbush (*Wikstroemia indica*). Rice bug (RB) *Leptocorisa* sp. is the most dominant insect species causing rice grain discoloration, low grain weight, and an increase in unfilled grains, resulting in rice yield reduction in the Philippines (Lee et al., 1986; Hwang et al., 2022). Historically, RBs destroyed up to 70% of wet season crops in the country, ranking as a primary rice pest in various regions of the Philippines in the 1980s (Litsinger et al., 2015). Chemical pesticides are the primary control for rice bugs, but their prolonged use may lead to resistance and resurgence prompting interest in botanical insecticides (Lestari et al., 2024). Extracts from various plant species are used to repel black bugs, including Indian Berry (*Anamirta cocculus*), Sugar Apple (*Annona squamosa*), Areca (*Areca catechu*), Chili (*Capsicum frutescens*), Poison Vine (*Derris elliptica*), Indian Spurgetree (*Euphorbia neriifolia*), Madre de Cacao (*Gliricidia sepium*), Taiwanese Cheesewood (*Pittosporum pentandrum*), Pongame Oiltree (*Pongamia pinnata*), and Indian Stringbush (*Wikstroemia indica*). Rice black bug (RBB) *Scotinophara* spp. is an invasive rice pest in the Philippines known for targeting all growth stages of rice plants, including "deadheart" damage in the vegetative stage, "whitehead" in the reproductive stage, and "bugburn" upon intensive bug feeding leading to total crop loss (Barrion et al., 2007; Torres et al., 2010). From its first outbreak in 1982, RBB continues to persist in rice farms, causing rice yield reduction loss of up to 70% (Barrion et al., 1982; DSWD-DROMIC, 2024). Due to this, RBB management remains challenged and could be managed by integrated pest management (IPM) strategies. Plant parts from various species, including Areca (*Areca catechu*), *Cissampelos taeniatus*, Poison Vine (*Derris elliptica*), Hairy Fleabane (*Erigeron sumatrensis*), Fig Tree (*Ficus* sp.), Wax Plant (*Hoya pubicalyx*), Dwarf Thornless Fern (*Marattia* sp.), Fragrant Premna (*Premna odorata*), and Mullein Nightshade (*Solanum verbascifolium*), have been utilized for targeting armyworms. Over the years, the Philippines has faced several outbreaks of armyworm *Spodoptera* sp., including Black armyworm, *S. exempta* (Walker), and beet armyworm *S. exigua* (Hübner) that targets corn, rice, sugarcane crops, and onion. However, the arrival of Fall armyworm (FAW) *Spodoptera frugiperda* in June 2019 (Navasero et al., 2019) has dramatically

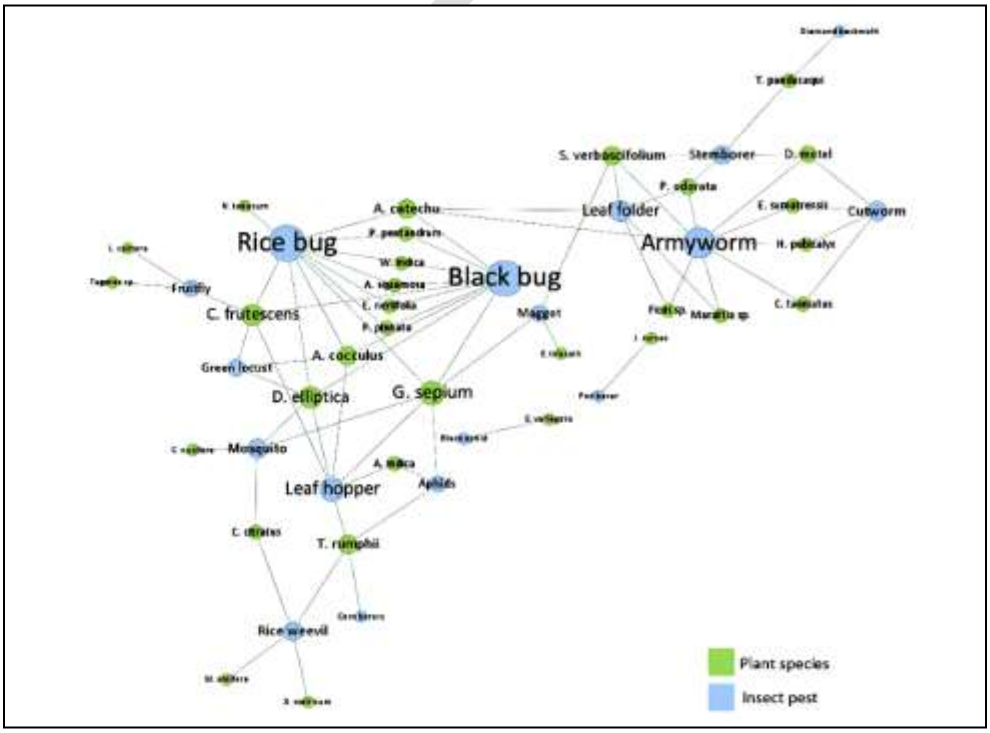

Fig. 9: Network Graph of insect pest and plant species interaction.

affected corn and rice production in the Philippines, with extensive damage to corn farms in 70 out of 79 provinces as of 2020 (Cuaterno, 2021). FAW is a significant pest of corn and rice, known for its corn-strain dominant polymorphism, protogynous sexual dimorphism, migratory range, extensive crop damage, and ecological adaptability to a variety of host plants, including both crops and weed species (Labonete et al., 2024). However, the application of botanical pesticide against FAW is not yet explored in the Philippines. With the current dilemma in insect pest infestations faced by farmers in the country, integrating traditional knowledge and botanical insecticide in pest management is crucial. Network analysis plays a crucial role in mapping and identifying potential botanical applications for underrepresented pest species. Integrating this approach with bioassays or chemical profiling can strengthen the validation of traditional practices and expand their applicability in sustainable agriculture.

Bioactive Compounds in Insecticidal Plants

Scientific validation is crucial in validating the effectiveness of insecticidal claims, as traditional and ethnobotanical knowledge alone may not fully establish their efficacy and safety. Two out of 32 studies (6.25%) identified bioactive compounds found in eleven out of 112 species (9.82%), indicating insecticidal action, potency, and applicability in sustainable pest management (Fig. 10). Alkaloid is identified in seven out of 112 species (6.25%), specifically *A. catechu, E. sumatrensis, T. pandacaqui, P. odorata, C. taeniatus, H. pubicalyx,* and *S. verbascifolium*. Alkaloid is one of the most basic organic compounds containing carbon, hydrogen, oxygen, and nitrogen that have anti-inflammatory, antibacterial, and anticancer activities. However, alkaloids have been recently explored for their role in botanical insecticides, affecting insects by causing cellular deterioration and hormonal imbalance (Fowsiya & Madhumitha, 2020; Wu et al., 2021). Saponins, a triterpenoid or steroidal glycosides compounds, were also reported in 3 out of 112 species (2.68%), specifically *C. taeniatus*, *H. pubicalyx*, and *S. verbascifolium*. Saponins are organic surfactants that exhibit insecticidal properties in diamondback moths (*Plutella xylostella* L.) and aphid (*Aphis craccivora* Koch) (Dolma et al., 2021; Tian et al., 2021). Allicin, an organosulfur compound reported only in *Allium sativum* is known for its antimicrobial and antifungal properties and have a potential alternative to synthetic insecticide (Li et al., 2022; Wang et al., 2022; Liu et al., 2023). Azadirachtin, a potent limonoid from *Azadirachta indica*, is known for its insect growth regulatory effects and feeding deterrence (Kilani-Morakchi et al., 2021). Polyphenolic compounds, a plant-derived secondary metabolite found in *P. odorata* have also been reported to have toxic effects on insects like *Spodoptera litura* (Hoesain et al., 2023). Gingerol from *Zingiber officinale* is also a phenolic compound, reported to be an effective insecticide against armyworms *Spodoptera* spp. (Keosaeng et al., 2023). Thiophenes, sulfur-containing heterocyclic compounds found in *T. erecta* have significant larvicidal effects against *Spodoptera litura* and *Corcyra cephalonica* (Kannan et al., 2024). Secondary metabolites, like synthetic insecticides, have a significant impact on insects through varying modes of action classified by the Insecticide Resistance Action Committee (2024). Protein suppression, growth inhibition, and respiration interference is observed in alkaloids and saponins, causing oxidative stress and hormonal disruption that leads to insect developmental abnormalities. Azadirachtin, allicin, and gingerol cause growth development, molting disruption, and feeding deterrence in insects. Thiophenes interfere with mitochondrial respiration, and polyphenolic compounds inhibit digestive enzymes in insects, causing mortality. The alignment of these scientifically validated mechanisms with long-standing traditional practices highlights the empirical foundation of indigenous knowledge, reinforcing the efficacy of insecticidal plants that have been utilized for decades by local farmers and ethnic farming communities in the Philippines.

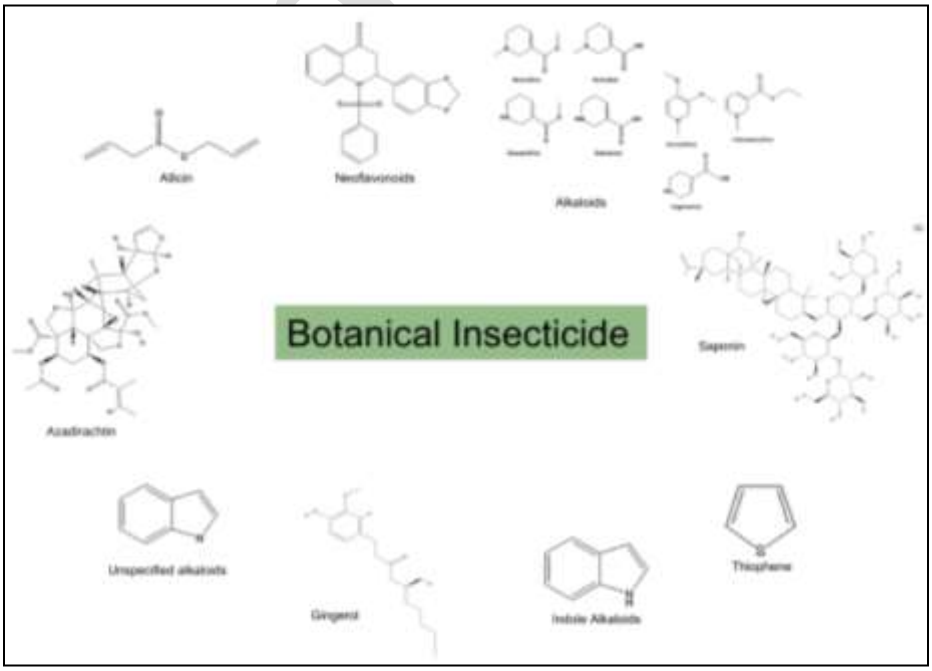

Fig. 10: Visualization of identified biochemical compounds from plants with insecticidal properties in the Philippines.

DISCUSSION

From the initial data search of 4896 studies, 32 studies with high quality and low bias risk have been identified through thorough analysis. Of this, 199 ethnobotanical and local survey data comprising 112 species, 91 genera, and 45 families were extracted. The highest number of studies in this systematic review were conducted in Region IV-A (CALABARZON) and the Cordillera Administrative Region (CAR) of Luzon, where indigenous groups such as the *Isnag/Apayao*, *Ifugao, Kalanguya*, and *Tulgao*, along with local rice and vegetable farmers, practice traditional agricultural use of botanical insecticides. With a growing interest in the traditional use of insecticidal plants since 2020, observed implications need to be explored. The dominance of Fabaceae in insecticidal plant use suggests that species from this family possess bioactive compounds effective against pests and are well-adapted to the tropical climate of the Philippines. The families Fabaceae, Asteraceae, Lamiaceae, Euphorbiaceae and Solanaceae were found to have the most plant species with insecticidal potential, and have also been reported in other global areas such as Sub-Saharan Africa (Shilaluke & Moteetee, 2019), Mexico (Jessen et al., 2022), China (Guo et al., 2024), and Malaysia (Bharathithasan et al., 2024). This widespread distribution suggests a possible evolutionary advantage, as species from these families are known to produce secondary metabolites that serve as a chemical defense mechanism. This has critical implications for sustainable pest management, as locally available plant species can be further explored for scalable, eco-friendly alternatives to synthetic pesticides. Additionally, it highlights the potential of these plant families in Integrated Pest Management (IPM) programs, reinforcing the importance of conserving biodiversity and traditional agricultural knowledge in developing cost-effective, culturally inclusive pest control solutions. Beyond practicality, the widespread use of traditional and natural insecticides reflects the preservation of indigenous agricultural knowledge. Many rural communities have long relied on plant-based pest management, with these methods being passed down through generations as part of traditional farming practices. These practices not only promote sustainable and organic farming but also contribute to local economic resilience by reducing dependence on commercial pesticides. However, this review has several limitations. Primarily, only plants used for their insecticidal properties that are extracted from ethnobotanical studies and qualitative and quantitative surveys were included in this review. Although some plants have been reported with bioactive compounds and secondary metabolites identified to cause their insecticidal activities, most of the plants included in this review were not yet experimentally proven, with surveyed data lacking in phytochemical analysis and toxicological data tested in insects. Moreover, taxonomic information on plant species was based only on the reported studies, and most studies did not consult a taxonomist for the identification, leading to potential errors in morphological identification. Nevertheless, this study provides a comprehensive list of plants used as botanical insecticides by different indigenous groups and local farming communities for sustainable and accessible pest management.

Conclusion

This study is the first of its kind to provide a comprehensive systematic review and network analysis of insecticidal plants used by local farmers and indigenous farming communities in the Philippines. A total of 32 studies identified to have high quality and low bias were retrieved and analyzed, primarily from Luzon, home to a wide variety of ethnic groups and local farmers with high national crop production. Of these, a total of 112 species have been identified that are specifically used for their insecticidal properties, identified to be native, naturalized, cultivated, and cryptogenic in the Philippines. The plants belonging to the family Fabaceae have the most abundance, with 13 genera and 14 species. The genus *Ficus* has the highest number of species of 5, while the genera *Capsicum* and *Cymbopogon* were the most reported, with 12 counts each. The most common plant species utilized were Madre de Cacao *Kakawate* (*Gliricidia sepium*) with 11 counts, Lemon Grass *Tanglad* (*Cymbopogon citratus*) with 10 counts, Neem, *Balunga* (*Azadirachta indica*) and Poison Vine, *Tubli* (*Derris elliptica*) with seven counts each. The most used plant parts were leaves, with 101 counts. The most common mode of extraction was mechanical extraction by pressing, grinding, crushing, or shredding the plant parts, with 59 mentions, and are mainly applied through direct spray on crops, with 84 mentions. Moreover, most plant species identified are used against major insect crops such as rice bugs, black bugs, and armyworms. Bioactive compounds and secondary metabolites of some insecticidal plants that have an impact on insects were also reported. This review highlights the unexplored and undocumented traditional knowledge of insecticidal plants in a biodiverse, agriculture-driven country which could be the key to a new sustainable insect pest management. While this review highlights the rich ethnobotanical knowledge in the Philippines and its applications to pest management, there is still a gap in standardization of extraction method, stability of formulation, consistency of efficacy across environmental conditions, and shelf-life longevity. It is highly recommended for another in-depth systematic review of bioactive compounds of all identified species included in this review to identify insecticidal properties that have been scientifically validated. Furthermore, there is limited comparative data on their long-term effectiveness and economic viability for farmers which is important on policy frameworks integration. Evaluating policies on registration, safety, and processing is crucial for its successful commercial adoption.

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Data Availability: The additional data of this study can be obtained from the corresponding author upon a justified request.

Author's Contributions: PRISMA-guided systematic review, conducted quality and bias risk assessment, network analysis, and wrote the manuscript (H.J.P.L.); Assisted in review and methodology assessment (M.A.J.T.); Verified the review and analysis validity (E.A.J); Contributed to result interpretation and manuscript writing (C.G.D.).

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