



Inventory of Plant Species with Potential as Botanical Pesticide in Bowi Subur Village, Masni District, Manokwari Regency

Inventarisasi Jenis Tumbuhan Berpotensi sebagai Pestisida Nabati di Desa Bowi Subur, Kecamatan Masni, Kabupaten Manokwari

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Abstrak

Penggunaan pestisida sintetik telah banyak mencemari lingkungan, sehingga diperlukan upaya untuk mencari alternatif pestisida alami dari tumbuhan. Penelitian ini bertujuan menginventarisasi jenis tumbuhan yang berkhasiat sebagai pestisida nabati di Kampung Bowi Subur Kecamatan Masni, Kabupaten Manokwari. Metode penelitian adalah metode deskriptif dengan teknik sampling menggunakan kombinasi jalur berpetak. Penelitian dilakukan pada 13 jalur sesuai dengan jalur perumahan yang ada di Kampung Bowi Subur, kemudian didokumentasikan dan dilakukan penelusuran pustaka terkait. Hasil inventarisasi secara keseluruhan ditemukan sebanyak 46 jenis tumbuhan dari 25 Suku yang memiliki sifat pestisida. Sebanyak 35 jenis di antaranya berpotensi dalam mengendalikan hama, tujuh jenis dapat digunakan untuk mengatasi penyakit dan satu jenis untuk mengendalikan gulma. Selain itu, ada tiga jenis tumbuhan yang bisa digunakan baik untuk mengendalikan hama maupun penyakit. Mayoritas bagian yang dimanfaatkan sebagai pestisida adalah daun, dari 19 jenis tumbuhan. Kebanyakan jenis tumbuhan yang dimanfaatkan sebagai pestisida alami adalah kelompok tumbuhan budidaya.

Kata kunci: *pestisida nabati, insektisida, inventarisasi, Papua Barat*

Abstract

Using synthetic pesticides has polluted the environment, so efforts are needed to find alternative natural pesticides from plants. This study examines plant species with potential as botanical pesticides in Bowi Subur Village, Masni District, Manokwari Regency. The research method used is descriptive, with a sampling technique combining plot line transects, and it was conducted along 13 transects corresponding to the housing areas in Bowi Subur Village. The plants were documented, and relevant literature was reviewed. The inventory results identified 46 plant species from 25 families with pesticidal properties. Of these, 35 species are used for pest control, seven for disease management, and one for weed control. Additionally, three plant species were found to be effective for both pest and disease control. Most parts used for pesticide purposes are leaves, accounting for 19 plant species. We conclude that most species of plants used as natural pesticides are cultivated plants. Therefore, wild plants with potential for botanical pesticides are essential for further study their properties.

Keywords: *botanical pesticides, insecticides, inventory, West Papua*

INTRODUCTION

Indonesia is a megadiverse country with abundant natural resources, particularly biological resources. One such biological resource is flora. This rich variety of flora can be utilized for food, shelter, clothing, cosmetics, medicine, and other purposes. Plants used as medicine contain active compounds that can be employed as medicinal ingredients for humans or as botanical pesticides. Medicinal plants have been used for a long time, and botanical pesticides have been known to people for around three centuries, dating back to French farmers in 1690 who used leaf extracts for pest control. [1].

Botanical pesticides are those derived from plants. They can act as killers or disruptors of pests, diseases, and weeds through unique mechanisms, singly or combined. Botanical pesticides can be produced using advanced technology on an industrial scale, but they can also be made by farmers or individuals using simple technologies. Botanical pesticides are simply prepared as extracts, juices, infusions, and decoctions of plant parts, such as roots, tubers, stems, leaves, and seeds. Currently, farmers increasingly prefer botanical pesticides over chemical pesticides. This preference is because chemical pesticides, when misused, can lead to pests or other plant pests (OPT) becoming resistant. Additionally, chemical pesticides are relatively expensive compared to botanical pesticides, making the latter a

viable alternative for maintaining and stabilizing agricultural productivity [2], [3].

Agricultural plant species include rice, vegetables, seasonal fruits, annual vegetables and fruits, medicinal plants (biofarmaka), and others. According to survey data from the Central Statistics Agency of Indonesia [4]. Some Provinces in Indonesia experienced an increase in productivity, while many saw a decrease in productivity from 2018 to 2019. According to the Central Statistics Agency of Manokwari Regency [5]. Agricultural productivity in several districts of Manokwari Regency decreased during 2018 - 2019. This decline is attributed to a reduction in harvested area or agricultural land, although some districts saw an increase in agricultural land area, productivity still declined. Other factors may contribute to reducing agricultural productivity, such as attacks by plant pests and diseases (OPT).

Plant pests and diseases (OPT) are significant factors that impede the increase in agricultural productivity. OPT can attack plants at almost all stages of growth, including before planting. In agriculture, people are familiar with the names of plant pests and diseases (OPT) that frequently damage crops. For example, in vegetables, common pests include aphids, cabbage worms, leaf miners, root rot diseases, potato cyst nematodes (PCN), bacterial wilt, and many others. OPT can reduce production

quality and decrease the quality and price of agricultural products [6].

The productivity of several species of agricultural or food crops in West Papua, specifically in Manokwari Regency, has experienced both increases and decreases or fluctuations from 2011 to 2015 [7]. The decline in agricultural productivity can be attributed to reduced harvested area or agricultural land, land conversion, decreasing soil fertility, light, temperature, humidity, nutrition, and disturbances from plant pests and diseases (pests, weeds, diseases). This suggests that the spread of OPT around Bowi Subur Village may be extensive. Therefore, research on plant species with potential as botanical pesticides in Bowi Subur Village, Masni District, Manokwari Regency, is necessary.

Information on plant species with potential as botanical pesticides in Bowi Subur Village, Masni District, Manokwari Regency is still

lacking. This serves as the basis for conducting this research, which aims to provide the community with information on plant species that are effective as environmentally friendly botanical pesticides and can replace chemical pesticides, which are more expensive and have adverse environmental effects. This research examines plant species with potential as botanical pesticides in Bowi Subur Village, Masni District, Manokwari Regency.

METHODS

Study site

This study was conducted from May to September 2021 in Bowi Subur Village, Masni District, Manokwari Regency. Identification and further analysis were performed at the Botany Laboratory of the Faculty of Mathematics and Natural Sciences, University of Papua (UNIPA). The research location map is shown in Figure 1.

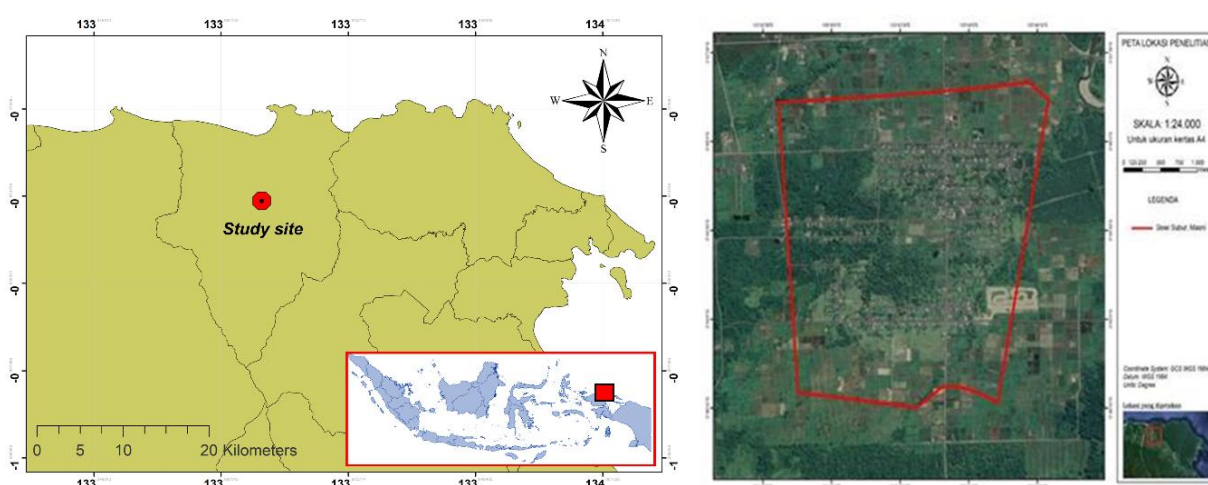


Figure 1. Research location map

Data Collection

This study uses a descriptive method with a sampling technique that combines plot line transects across 13 transects in Bowi Subur Village. Plant species with potential as pesticides were inventoried and documented and then classified according to their families and the parts used as pesticides, referencing relevant literature [8], [9].

Data Analysis

All plant species collected were identified based on their roots, stems, and leaves' morphological characteristics and analyzed. Plants with pesticidal properties were classified according to the target pests they control, matched with relevant literature [21], [52].

RESULTS AND DISCUSSION

Based on field observations, documentation, and a review of relevant literature, 46 plant species with potential as botanical pesticides were identified. These 46 pesticidal plant species can be grouped into 25 families (Table 1). The family with the most species is *Asteraceae*, with a total of 6 species. The *Asteraceae* family is the most abundant group of flowering plants. In addition, the species group of the *Asteraceae* family has several bioactive compounds that are beneficial for human health, industrial raw materials, and have potential as botanical pesticides. [10], [11]. One of the advantages of the *Asteraceae* family is that it has

essential oils and aromatic compounds, which are often extracted into botanical pesticides. [12]. The status of pesticide plant species found in Bowi Subur Village includes 26 cultivated and 20 wild species (Table 1).

The pesticides listed in Table 1 can be divided into four major groups: pesticides for controlling pests, as many as 35 species; controlling diseases, seven species; controlling weeds, one species; and three plants that can control both pests and diseases. Therefore, it can be said that the potential of plants as botanical pesticides in Bowi Subur, Masni District, Manokwari Regency is dominated by insecticides and larvicides. These results are similar to the research of Yuliartati et al. [13]. Over 80% of plants inventoried in several regencies in West Sumatra can generally be applied as bioinsecticides, including caterpillars. Botanical pesticides that can control the abundance of animals, especially insects, can be an essential alternative for the health of the food chain in an ecosystem. This is because synthetic pesticides can cause insect resistance if applied at inappropriate doses, and even synthetic pesticide residues can pollute the environment, enter the food chain, and accumulate at certain trophic levels. [14], [15]. The potential of plants as botanical pesticides, especially insecticides and larvicides in Table 1, needs further development.

Eighty percent of global agricultural crop production has decreased due to pests and

diseases. One of the worst contributors to damage is the insect group, including caterpillars. [16]. In Manokwari, the intensity of pest attacks originating from insect larvae such as "sundep" (*Scirpophaga incertulas*) on rice, "tritip caterpillars" (*Plutella xylostella*) and "grayak caterpillars" (*Spodoptera litura*) on mustard greens has significantly reduced crop production. [17] [18], [19]. As a bioprospecting effort, this study offers plant species that have the potential to counter these insect larvae. For example, *Ruellia tuberosa*, coconut shell (*Cocos nucifera*), areca nut peels and fruit (*Areca catechu*), durian fruit peels (Durio

zibethinus), mango leaves (*Mangifera indica*), and pulai bark (*Alstonia scholaris*) can control *Spodoptera litura* (Table 1).

In the research location, betel plants (*Piper betle*) were also found in sufficient abundance; this plant is quite effective as a biocontrol for "tritip caterpillars" (*Plutella xylostella*) [17]. Meanwhile, the abundance of species belonging to the Asteraceae family in Bowi Subur Village, Masni District, such as *Cosmos caudatus* and *Bidens pilosa*, can increase the natural enemies of *Scirpophaga incertulas* so that they can be applied as biological control agents. [20].

Table 1. Plant species with potential as botanical pesticides

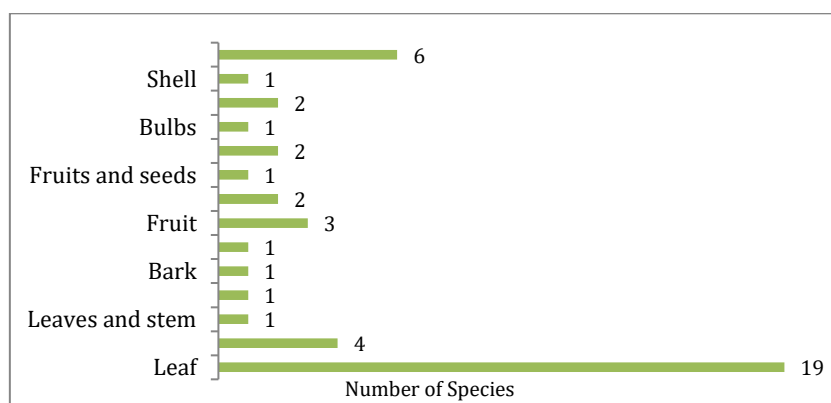
| No | Family/Species | Part Used | Plant Status | Efficacy/Target Pests |
|----------------------|---|---------------|--------------|---|
| Acanthaceae | | | | |
| 1 | Gandarusa (<i>Justicia gendarussa</i> Burm.f.) | Leaf | Cultivated | Prevents damage to plants caused by insects or pests [21]. |
| 2 | Pletekan (<i>Ruellia tuberosa</i> L.) | Whole plant | Wild | Controls armyworm pests [22]. |
| Amaranthaceae | | | | |
| 3 | Bayam hijau (<i>Amaranthus tricolor</i> L.) | Leaf and stem | Cultivated | Controls pests [6]. |
| Anacardiaceae | | | | |
| 4 | Kedondong (<i>Spondias dulcis</i> Parkinson.) | Leaf | Cultivated | Biolarvacide of <i>Aedes aegypti</i> [23]. |
| 5 | Mangga (<i>Mangifera indica</i> L.) | Leaf | Cultivated | Biocontrol <i>Spodoptera litura</i> [24]. |
| Annonaceae | | | | |
| 6 | Sirsak (<i>Annona muricata</i> L.) | Leaf | Cultivated | Controls brown planthoppers, grasshoppers, and caterpillars [25]. |
| Apocynaceae | | | | |
| 7 | Kamboja (<i>Plumeria</i> sp.) | Flower | Cultivated | Controls insects [26]. |
| 8 | Pulai (<i>Alstonia scholaris</i> (L.) R.Br.) | Bark | Wild | Kills pests (<i>Spodoptera litura</i>) [27]. |
| Areceaceae | | | | |
| 9 | Kelapa (<i>Cocos nucifera</i> L.) | Shell | Cultivated | Kills armyworms [28]. |
| 10 | Pinang (<i>Areca catechu</i> L.) | Seed | Cultivated | Controls mealybugs [29]. |

Table 1. Plant species with potential as botanical pesticides (Cont.)

| No | Family/Species | Part Used | Plant Status | Efficacy/Target Pests |
|----------------------|---|------------------------|--------------|---|
| 11 | Asteraceae Ajeran (<i>Bidens pilosa</i> L.) | Whole plant | Wild | Controls aphids, mites, and cutworms [6]. |
| 12 | Bandotan (<i>Ageratum conyzoides</i> L.) | Leaf | Wild | General pest control [6]. |
| 13 | Kenikir (<i>Cosmos caudatus</i> Kunth.) | Leaf, flower, and root | Cultivated | Acts as an insecticide, fungicide, and nematicide [6]. |
| 14 | Tapak lima (<i>Elephantopus scaber</i> L.) | Whole plant | Cultivated | Suppresses downy mildew disease in sweet corn [30]. |
| 15 | Sembung rambat (<i>Mikania micrantha</i> Kunth.) | Leaf and stem | Wild | Acts as a bioherbicide against <i>Melastoma</i> weeds [31]. |
| 16 | Wedelia (<i>Sphagneticola trilobata</i> (L.) Pruski) | Leaf | Wild | Suppresses the growth of cabbage webworm larvae (<i>Crociodolomia pavonana</i> F.) [32]. |
| Bombacaceae | | | | |
| 17 | Durian (<i>Durio zibethinus</i> L.) | Fruit peel | Cultivated | Controls armyworms [33]. |
| Caricaceae | | | | |
| 18 | Pepaya (<i>Carica papaya</i> L.) | Leaf and stem | Cultivated | Controls pests [25]. |
| Cyperaceae | | | | |
| 19 | Rumput teki (<i>Cyperus kyllingia</i> Endl.) | Tuber | Wild | Acts as a larvicide [34]. |
| Euphorbiaceae | | | | |
| 20 | Jarak pagar (<i>Jatropha curcas</i> L.) | Fruit | Cultivated | Repels caterpillars (<i>Spodoptera exigua</i>) and insects [35]. |
| 21 | Ketela pohon (<i>Manihot esculenta</i> Crantz.) | Leaf | Cultivated | Acts as an insecticide [36]. |
| 22 | Petikan kebo (<i>Euphorbia hirta</i> L.) | Leaf | Wild | Controls powdery pests [37]. |
| Fabaceae | | | | |
| 23 | Gamal (<i>Gliricidia sepium</i> (Jacq.) Kunth.) | Leaf and bark | Cultivated | Acts as an insecticide, rodenticide, and repellent [6]. |
| 24 | Kacang asu (<i>Calopogonium mucunoides</i> Desv.) | Leaf and stem | Wild | Controls pests [38]. |
| 25 | Ketepeng cina (<i>Senna alata</i> (L.) Roxb.) | Leaf | Wild | Controls powdery pests [37]. |
| 26 | Petai (<i>Parkia speciosa</i> Hassk.) | Seed | Cultivated | Acts as a botanical insecticide [39]. |
| Lamiaceae | | | | |
| 27 | Kemangi (<i>Ocimum basilicum</i> L.) | Leaf | Cultivated | Controls insects [40]. |
| 28 | Lenglangan (<i>Leucas lavandulifolia</i> Sm.) | Whole plant | Wild | Acts as an insecticide [6]. |
| Liliaceae | | | | |
| 29 | Bawang merah (<i>Allium cepa</i> L.) | Bulb | Cultivated | Controls pests (caterpillars) [25]. |
| Mimosaceae | | | | |
| 30 | Putri malu (<i>Mimosa pudica</i> L.) | Whole plant | Wild | Prevents leaf rot and <i>Alternaria</i> [6]. |
| Moraceae | | | | |
| 31 | Nangka (<i>Artocarpus heterophyllus</i> Lam.) | Leaf | Cultivated | Acts as a biolarvicide [41]. |
| Musaceae | | | | |
| 32 | Pisang kepok (<i>Musa acuminata</i> × <i>balbisiiana</i> Colla.) | Fruit peel | Cultivated | Controls insects [42]. |

Table 1. Plant species with potential as botanical pesticides (Cont.)

| No | Family/Species | Part Used | Plant Status | Efficacy/Target Pests |
|-----------------------|--|----------------|--------------|---|
| Myrtaceae | | | | |
| 33 | Jambu air (<i>Syzygium aqueum</i> (Burm.f.) Alston.) | Leaf | Cultivated | Acts as a botanical larvicide [43]. |
| 34 | Jambu biji (<i>Psidium guajava</i> L.) | Leaf | Cultivated | Acts as an ovicide against golden apple snails [44]. |
| 35 | Salam (<i>Syzygium polyanthum</i> (Wight) Walp.) | Leaf | Cultivated | Acts as an antifungal agent [45]. |
| Pandanaceae | | | | |
| 36 | Buah merah (<i>Pandanus conoideus</i> Lam.) | Fruit | Cultivated | Suppresses bole weevils and thrips pests [46]. |
| Phyllanthaceae | | | | |
| 37 | Meniran (<i>Phyllanthus urinaria</i> L.) | Whole plant | Wild | Click or tap here to enter text. Controls aphids [47] |
| Piperaceae | | | | |
| 38 | Sirih (<i>Piper betle</i> L.) | Leaf | | Kills sucking pests [6]. |
| 39 | Sirih hutan (<i>Piper aduncum</i> L.) | Leaf | Wild | Inhibits the growth of the fungus <i>Colletotrichum capsici</i> , which causes anthracnose in red chili [48]. |
| 40 | Rambutan (<i>Nephelium lappaceum</i> L.) | Leaf | Cultivated | Suppresses larvae of <i>Aedes aegypti</i> mosquitoes [49]. |
| Solanaceae | | | | |
| 41 | Cabai rawit (<i>Capsium frutescens</i> L.) | Fruit and seed | Cultivated | Acts as a bioinsecticide to reduce pest attacks on white oyster mushrooms [50]. |
| 42 | Takokak (<i>Solanum torvum</i> Sw.) | Fruit | Wild | Controls pests and diseases [51]. |
| Verbenaceae | | | | |
| 43 | Bunga pagoda (<i>Clerodendrum paniculatum</i> L.) | Leaf | Wild | Stimulates systemic resistance in cayenne pepper plants against Cucumber Mosaic Virus [6]. |
| 44 | Pecut kuda (<i>Stachytarpheta jamaicensis</i> (L.) Vahl.) | Leaf | Wild | Acts as an antifungal agent [52]. |
| Zingiberaceae | | | | |
| 45 | Jahe (<i>Zingiber officinale</i> Roscoe) | Rhizome | Cultivated | Acts as a repellent to prevent pest infestation [6]. |
| 46 | Kunyit (<i>Curcuma longa</i> L.) | Rhizome | Cultivated | Acts as an insecticide, fungicide, and repellent [6]. |

**Figure 2.** Parts of plants used for making pesticides

The plant part most used as a pesticide is the leaf, with 19 species, whereas the least used parts are tubers, husks, flowers, bark, combinations of leaves and bark, leaves, flowers, roots, and fruits and seeds, each with one species (Figure 2).

Leaves are extensively utilized because they contain numerous active compounds that can be used as botanical pesticides. Additionally, leaves are one of the plant parts that are readily available, easy to process, and abundant in nature [53]. For example, betel leaf (*Piper betle*) contains essential oils (allyl catechol, eugenol, methyl eugenol, carvacrol, caviolol, cavibetol, cineole, estragole), nicotinic acid, amino acids, sugars, carotene, thiamine, starch, riboflavin, tannins, and vitamin C. Some of these compounds have insecticidal properties [6].

Another example is guava leaf (*Psidium guajava*), which contains saponins, flavonoids, tannins, terpenoids, and alkaloids that can kill golden snails and inhibit egg hatchability [44]. Compounds contained in leaves also tend to remain until senescence. For example, wet leaf litter of *Dracontomelon dao* still contains cardol, glycerol, and anacardic acid compounds, which are characterized by a pungent/sharp odor and can also acidify the soil [54], [55]. Therefore, most local people in the tropics use leaves as ingredients for traditional

medicine, potions, and even herbal pesticides.

CONCLUSION

In Kampung Bowi Subur, District Masni, Manokwari Regency, there are 46 species of plants with pesticide properties from 25 families. More than 80% of the plants inventoried have the potential as botanical pesticides, while the rest (c.a. ~40%) can be used as disease and weed controllers. The part of the plant most widely used as a botanical pesticide is the leaves, which number 19 species, or around 41% of the total plants inventoried.

CONFLICT OF INTEREST

I hereby declare that there is no conflict of interest in writing this scientific work.

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