

Research Article

Survey of Major Diseases on Medicinal and Aromatic Plants Growing Areas of Ethiopia

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Abstract

Medicinal and aromatic plants are industrial plant that are primarily used for therapeutic, aromatic and culinary purposes as components of cosmetics, medicinal products, health foods and other natural health products. Like other cereal crops, these potential medicinal and aromatic plants are constantly in grave danger from disease attack. The aim of this study was to assess the most prevalent diseases on prioritized medicinal and aromatic plants. Survey was conducted at Wondo Genet Agricultural research stations and herb growing companies in Ethiopia. Survey fields were observed from vegetative to maturity stage of the plant to assess the pest status. A total of 11 medicinal and aromatic plants were assessed in four different locations and these herbs were attacked by various diseases. Rust disease was the most serious problem on Aloe vera and Lemon grass, accounting for 30-40 percent of disease severity at Wondo Genet. In Butajira, powdery mildew was the most common disease found on sage, with a 20 percent severity. Downy mildew was recorded as a major disease on basil plants in Hawassa and Debre Zeit, with a 30-35 percent severity. Therefore, identification of the pathogen's causing agents and integrated disease management for the major recorded diseases of medicinal and aromatic plants needs further research.

Keywords

Medicinal Aromatic Plants, Disease, Survey, Documentation, Ethiopia

1. Introduction

Medicinal plants are the starting materials for value added processed natural ingredients such as essential oils, dry and liquid extracts and oleoresins. There is a clear industrial demand for MAPs and increased production of herbal health care formulations; herbal based cosmetic products and herbal nutritional supplements. In addition, traditional health care practitioners, traditional healers and consumption at the household level have all contributed to the demand for herbal medicinal products. MAPs are industrial plant that are primarily used for therapeutic, aromatic and culinary purposes as

components of cosmetics, medicinal products, health foods and other natural health products. Medicinal plants/herbs are also used in natural dye, pest control, food, perfume, tea and so on. In many countries, different kinds of medicinal plants/herbs are used to keep ants, flies, mice and flee away from homes and offices. Now a days medicinal herbs are important sources for pharmaceutical manufacturing.

WHO estimated that 80 percent of people worldwide rely on herbal medicines for some aspect of their primary health care needs. According to WHO, around 21,000 plant species

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have the potential for being used as medicinal plants. The Wondo Genet agricultural research center botanical garden housed only 26 registered Ethiopian aromatic and medicinal plant varieties. This plant produces essential oil, which is used in a variety of industries. Lemon grass, citronella, eucalyptus, geranium, and mint, for example, are among the most commonly used plants for oil production. The three most commonly used parts of medicinal and aromatic plants are the leaves, roots, and flowers [1].

However, these useful medicinal and aromatic plants, like other cereal crops, are always vulnerable to disease attack. Many diseases, including leaf spots, leaf blight, root rot, and wilt, can cause serious damage to MAPs [2]. Diseases are frequently occurred on these plants at different cultivation areas of Ethiopia [3]. Disease occurrence, incidence, infestation and damage level should be surveyed and documented. Otherwise, there will not be a demand for MAP's production without monitoring and controlling of major diseases of MAPs. Therefore, the goal of this study is to survey major diseases on prioritized medicinal and aromatic plants for further pest management research works. This study was proposed to survey, identify and determine economic importance of major diseases in MAPs growing areas of Ethiopia.

2. Material and Methods

The survey was carried out at Wondo genet (Botanical Garden), Hawassa (Green Mark Herb plc), Butajira (Green Path plc) and Debre Zeit (Joy tech plc) location for two consecutive years (2020 to 2022 GC) at the vegetative and maturity stage of the MAPs grown in the area. The detailed description of the study area is provided below (Table 1).

Five random sample plants were taken from each of the main stem's upper, middle and lower canopy layers to assess disease prevalence. Sample infected plant parts by diseases was collected from the sampling fields and take to the plant protection laboratory for further identification.

During survey, necessary information on damaging symptoms of the disease, weather condition, plant age or stage, etc, were collected critically. Data such as number of diseased plants versus total number plants, damaged plant parts versus total area of plant tissue were recorded to determine percent incidence (infestation) and severity (damaged level). The severity and incidence of disease were assessed using a visual assessment key [9]. The disease incidence was calculated as incidence is the number of diseased plants divided by total number of plants examined times 100. Similarly, disease severity was assessed as severity is equal to Area of plant tissue affected divided by total area times 100.

Table 1. Site description of MAPs disease survey areas in Ethiopia.

| Survey area | Survey site | Latitude | Longitude | Rain fall (mm) | Altitude (masl) | Annual average temperature (°C) | |
|-------------|------------------|------------|------------|----------------|-----------------|----------------------------------|-------|
| | | | | | | Min | Max |
| Wondo Genet | Botanical garden | 7 0 192' N | 380 382' E | 1000 | 1876 | 12.02 | 6.72 |
| Hawassa | Green mark plc | 7 0 05' N | 390 29' E | 964 | 1652 | 12.94 | 27.34 |
| Butajira | Green path plc | ---- | ---- | ---- | ---- | --- | ---- |
| Debre Zeit | Joy Tech plc | 8 0 44' N | 380 58' E | 851 | 1891 | 12.22 | 25.72 |

3. Result and Discussion

The present survey study assessed the major diseases of prioritized Medicinal and Aromatic Plants in the major growing areas of Ethiopia during 2020 year. Herb growing company on four locations namely Wondo Genet, Hawassa, Butajira and Debre Zeit were surveyed to find out the major diseases of MAPs. The survey result revealed a total of ten different diseases on twelve MAPs were recorded. Each disease associated with each MAPs are discussed in detail as follows.

3.1. Disease Associated with Lemongrass

Lemongrass, *Cymbopogon citratus*, is a perennial grass in the family Poaceae grown for its fragrant leaves and stalks which are used as a flavoring. Lemongrass widely used as insect repellent [4] and herbal tea [5]. It is also used to treat bronchitis, sinusitis, cold, fever, malaria, haemorrhoids, toothache, diarrhea, stomachache, headaches, muscular pain, digestive disorders, menstrual disorder, rheumatism and other joint pains [6].

The common disease associated with this plant was rust which is caused by a fungus. Leaf spot and leaf blight (*Cymbopogon* spp.) are among the several disease pathogens that affect medicinal and aromatic grasses in Ethiopia [7, 8].

Rust disease caused by *P. nakanishikii* was reported to be a serious disease on lemon grass.

The Lemongrass grown in Wondo Genet, Butajira and Debre Zeiet was highly affected by rust disease. The severity was estimated between 10 to 30% of the leaves were attacked. Brown leaves with yellow streaks are often a symptom of rust from spores spread by the wind or rain.

3.2. Disease Associated with Aloe Vera

Aloe vera, *Aloe barbadensis* is a herbaceous perennial plant belongs to the family Aloeaceae and extensively used in the cosmetic industry. It is a highly important and extensively cultivated medicinal plant worldwide ranging from tropical to temperate regions.

A fungus causing anthracnose and leaf spots are reported to affect yield and quality of gel adversely. Rust is a fungal disease with a small, pale yellow spots on leaves which expand and turn brown; orange spore masses may be present on underside of leaf; leaves may drop from plant. The other common disease of Aloe vera plant are anthracnose disease, basal stem rot, bacterial soft rot. Recent research works reported that Aloe vera is affected by rust disease at Wondo Genet field experiment. The rust pathogen (*Uromyces aloes*) is responsible for severe infection and it is a very serious limiting factor for Aloe vera production.

The current study revealed Aloe vera is affected by rust severely at wondo genet agricultural research center. The damage level is 40% severity with a symptom of yellow and black spot and root rot. The disease is characterized by the appearance of golden yellow big pustules, arranged concentrically on both sides of leaf which upon maturity turns brown to black. These leaves turned yellow and finally die depending on the severity of infection. Sometimes, severe infection may lead to premature death of the plant.

3.3. Disease Associated with Stevia

Stevia, *Stevia rebaudiana*, is a small perennial shrub that belongs to Asteraceae family. It is plant originating in South America where it widely used as sweetener. Stevia leaves contain multiple glycosides extracted for use as a natural low calorie sweetener [10]. *Stevia rebaudiana* Bertoni plant is the one that provides sweetness for many of today's stevia-based sweeteners [11]. The leaf is used for diabetes, obesity, cavities, hypertension, fatigue, depression, sweet cravings, and infections. The main uses of stevia are as a natural sweetener, for diabetes, high blood pressure, cavity prevention and as a weight loss aid.

The most common stevia disease are leaf spot, rust, mold, root rot, charcoal rot, anthracnose, blight, and mosaic virus. Symptoms include wilting, chlorotic leaves, necrotic leaves, bleached stem lesions and dead stem. Stevia may be affected by two lesion-producing fungal diseases, *Septoria steviae* and *Sclerotinia sclerotiorum* [12].

The symptoms are, dark brown lesions form on stems, near the soil line, followed by wilting and eventual collapse of the plant. Stem and root rot is caused by the fungus *sclerotium rolfsii* with yellowing and wilting of leaves symptoms. Stevia plants are usually full grown before diseases appear. As harvest time nears, commercial growers watch plants closely and harvest the entire crop at the first sign of disease.

At wondo genet botanical garden, Stevia was infected by root rot disease causes the leaf to wilt with a 20% of disease severity. Root rot is a common issue when growing stevia. Symptoms initially appeared as yellowing and drooping of leaves, followed by wilting of plants due to the rotting of roots. White cottony mycelial growth observed on the infected roots up to the collar region during humid climate. On the infected areas, small brown sclerotia also observed. The first report of root rot of stevia caused by *Sclerotium rolfsii* in India [13].

3.4. Disease Associated with Basil

Basil, *Ocimum basilicum*, is a short lived annual or perennial plant in the family Lamiaceae grown for its leaves which are used as a herb.

According to the survey result, basil plant was severely infected by downy mildew with 15% severity at wondo Genet botanical garden and Butajira green path plc location. Basil plant was infected by downy mildew with 35% severity at Hawassa green mark plc. The symptoms of downy mildew includes yellow leaves that have fuzzy, grey growth on the underside of the leaves and it is aggravated by overly wet condition.

At Debre Zeit joy tech Plc Company, downy mildew, virus and nematode are the major recorded diseases on basil varieties with a 30%, 10% and 5% severity respectively. The disease symptoms are yellowing leaves; discoloration often begins around middle vein and spreads outwards; gray fuzzy or downy growth on lower surface of the leaves; brown to black angular necrotic patches on the plant.

Fusarium wilt (*Fusarium oxysporum* f. sp. *Basilicum*), bacterial leaf spot (*Pseudomonas cichorii*), gray mold (*Botrytis cinerea*), Downy mildew (*Peronospora belbahrii*) and damping off or root rot (*Rhizoctonia solani*; *Pythium* spp.) are one of the most common and destructive basil diseases. The symptoms of nutrient deficiency might be caused by root knot nematode which also can infect basil [14].

3.5. Disease Associated with Sage

Sage, *Salvia officinalis*, is a perennial shrub in the family Lamiaceae grown for its aromatic leaves, which are used as a herb. Sage can be erect or grow along the ground and possesses a dense arrangement of woody stems with broad, elliptical, silvery-green leaves which are arranged alternately on the stems. Sage is an herb with many species and the two most common species are common sage (*Salvia officinalis*) and Spanish sage (*Salvia Lavandula efolia*).

Sage leaves are used fresh or dry as a culinary herb. Oil can be extracted from the leaves and flowers of the plant and is used as a flavoring in alcoholic drinks and as a scent in perfume. There are a multitude of uses for sage including culinary, medicinal, craft and ornamental. People commonly use sage for memory and thinking skills, high cholesterol, and symptoms of menopause. It is also used for pain after surgery, lung cancer, sore throat, sunburn, and many other conditions, but there is no good scientific evidence to support these uses [15].

The recorded diseases on sage plant at Butajira, Hawassa and Debre Zeit locations are powdery mildew with a 20% severity for each locations. The symptoms of the disease is white to grayish spot and powdery like texture on leaves.

3.6. Disease Associated with Mint

Mints is a group of aromatics; mostly perennial herbs belong to the genus *Mentha* and comprise approximately 20 species in the plant family Lamiaceae and are grown for their leaves which are widely used as a flavoring, medicines and fragrances. Mint leaves are used fresh or dried to make teas, jams and desserts. Essential oil can be extracted from the leaves and is used as a flavoring.

Mint plants are mainly possess erect, branching stems and oblong to ovate or lanceolate leaves arranged in opposing pairs on the stems. The leaves are often covered in tiny hairs and have a serrated margin. Mint plants produce a terminal flower spike and the flowers can be white or purple in color depending on variety.

Mint plants are fast growing and can become very invasive. They can reach heights of 60–90 cm and will continue to grow for many years once established. Mint may also be referred to by species and these include, but are not limited to peppermint, spearmint, water mint and Japanese mint.

The common disease of mint plant is fungal disease such as mint rust caused by *Puccinia menthae* which causes small, dusty, bright orange, yellow or brown pustules on undersides of leaves; new shoots may be pale and distorted; large areas of leaf tissue die and leaves may drop from plant.

The survey obtained that at Hawassa, green mark herb location, fusarium wilt causes 25% severity with a symptom of twist and curly leave, and stunted plant. At Debre Zeit joy tech plc, mint was affected by rust disease with a 20% severity and causes a yellow brown pustules undersides of leaves.

3.7. Disease Associated with Oregano

Oregano, *Origanum vulgare* is the name given to many species of perennial herb belonging to the genus *Origanum*, including the major species *Origanum vulgare* which is grown for its leaves which are commonly used as a herb in cooking. Oregano plants can be woody or herbaceous and possess multiple branching stems. The leaves are oval or round and are arranged alternately on the stems. The leaves of the ore-

gano plant are used fresh or dried as a herb in cooking. They may also be dried and used to extract essential oil which is used in soaps or as flavorings in wines and liqueurs.

Mint rust is the major fungal disease on oregano plant and the disease also affects mint and can spread from nearby mint plants. Small, dusty, bright orange, yellow or brown pustules on undersides of leaves; new shoots may be pale and distorted; large areas of leaf tissue die and leaves may drop from plant.

At Hawassa location, Oregano was affected by rhizocotinia and rust disease with a disease symptom of root rot, wilting and leave spot. The severity of the disease damage was 15%. At Debre Zeit location, the plant affected by botrytis with a gray mold symptom.

3.8. Disease Associated with Rosemary

Rosemary, *Rosmarinus officinalis*, is an erect, bushy evergreen shrub in the family Lamiaceae grown for its leaves which are used as a herb. The rosemary plant is usually erect in growth habit and possess branched woody stems with tufts of leaves. The leaves are opposite and usually bladelike and glossy green.

The plant produces clusters of 5–10 blue, purple or pink flowers on short lateral branches and small oval fruit. Rosemary plants can reach 2 m (6.6 ft) in height and can be productive for many years (up to 30 if conditions are favorable for its growth). Rosemary originates from the Mediterranean. Rosemary leaves can be used fresh or dried as an herb in cooking or in salads. The leaves and flowers can be used to extract rosemary oil which is used as a seasoning or as a scent in soaps and household products. Rosemary can be propagated from seed, cuttings, or by air layering. Seeds germinate slowly, emerging after 3–4 weeks, and have a low germination rate so vegetative propagation is preferred.

Fungal diseases such as cottony soft rot and downy mildew, bacterial disease like crown gall are the common disease on rosemary plant. The disease symptom is a white powder coats the leaves. In this study, powdery mildew was recorded as a major fungal disease of rosemary with 25% severity at Debre Zeit location.

3.9. Disease Associated with Lemon balm

Lemon balm (*Melissa officinalis*), is a lemon scented herb that comes from the same family as mint. The herb is native to Europe, North Africa, and West Asia, but it is grown around the world. It is considered as calming herb. It is grown not only in herb gardens or to attract bees, but also in crops for medicine, cosmetics, and furniture polish manufacturing.

Before the middle Ages, Lemon balm is used to reduce stress and anxiety, promote sleep, improve appetite, and ease pain and discomfort from indigestion including gas and bloating, as well as colic. It is also used to lift the spirits by steeping in wine, help heal wounds, and treat venomous insect bites and stings [14].

In the present study, Bacterial blight and leaf spot (septoria) diseases affects lemon balm with 10% of severity at Debrezeit location. Discolored lesions, dark brown, and angular necrotic spot are the symptoms associated with lemon balm disease.

3.10. Disease Associated with Arugula

Arugula is mostly an annual plant belonging to the Brassicaceae family. Arugula is a Mediterranean culinary herb with a unique blend of flavors uniting the taste of walnuts with peppery aromas. Arugula is widely used to spice-up vegetable salads, pasta dishes, rice, meat and fish. In addition to this, Arugula is used to relieve digestive disorders, boost the immune system and fight infections. The plant is rich in Iron and Lutein which is a pigment that helps maintain healthy eyes, heart and blood vessels, as well as reduce the risk of cancer.

Downy mildew, bacterial leaf spot and damping off were reported as the only three major disease problems on the arugula crop at New Jersey. However, downy mildew and bacterial leaf spot are the most common diseases, while damping-off occurs infrequently.

In the current study, downy mildew (*Peronospora*) with 10% severity and shows downy mold on under side at Debre Zeit location where as Botrytis with gray mold symptoms caused 10 % disease severity at Hawassa location.

3.11. Disease Associated with Chives

Chives (*Allium schoenoprasum*), a member of the Allium family and native to the Asian continent, are bulb-forming hardy perennial plants. Chives look like grass and produce beautiful lavender colored flowers. The grassy leaves are round hollow stems and grow up to 50 cm long and have a diameter of 2-3 mm.

This herb has culinary and medicinal properties. Finely chopped chives are used to flavor soups, butter, cheese, and used in salads and other dishes as it imparts a mild onion-like flavor. Chives are rich in iron, calcium, phosphorous, Vitamin A, and Vitamin C. Due to its sulphur content, chives are also used as a natural antibiotic. Chive oil extract is said to help lower blood levels of low-density lipoproteins.

Unlike other herbs and greens, chives are minimally affected by diseases. Insufficient nutrients in soil, especially calcium might result in burnt tips. Water stress conditions also might result in burnt tips. Some diseases that have been reported on chives are downy mildew (*Peronospora destructor*), rust (*Puccinia porri*) and smut (*Urocystis cepulae*) [14].

The survey revealed that the chives assessed at Hawassa and Debre Zeit location were infected by botrytis blight and downy mildew disease. The symptoms are chlorosis, tip part yellowing and death of plant tissue. The disease severity ranges 15 percent.



i) Lemongrass plant with rust fungal disease.



ii) Aloe vera with rust fungal disease



iii) Powdery mildew on rosemary (right).



iv) Powdery mildew disease on sage plan.

Figure 1. Diseases associated with medicinal and aromatic plants in the selected growing area of Ethiopia.**Table 2.** Medicinal and Aromatic plant diseases recorded in herb growing areas of Ethiopia.

| No. | Medicinal and Aromatic Plants | | Study location | Disease recorded | Damage part and symptoms | Incidence (%) | Severity (%) |
|-----|-----------------------------------|--------------|---|-------------------------------|--|---------------|--------------|
| | Scientific name | Amharic name | | | | | |
| 1. | <i>Cymbopogon citratus</i> | ሎማ ሳር | Wondo Genet, Butajira, Debere Zeit | Rust | Yellow spot on the upper and lower part of leaves. | 20-60 | 10-30 |
| 2. | <i>Aloe adigratana Reynolds</i> | ፊት | Wondo Genet | Rust | Yellow and black spot, root rot | 80 | 40 |
| 3. | <i>Stevia aachalensis Hieron.</i> | ስቴቪያ | Wondo Genet | Root rot | Leaf Wilting | 40 | 20 |
| 4. | <i>Ocimum basilicum L</i> | በሰቢላ | Wondo Genet, Butajira, Hawassa, Debere Zeit | Downy mildew, Virus, Nematode | purple gray fuzzy mold at Lower leaves, yellowing foliage | 30-70 | 15-35 |
| 5. | <i>Salvia officinalis</i> | ሴጅ | Butajira, Hawassa, Debere Zeit | Powdery mildew | White to grayish spot on leaves, powdery like texture | 40 | 20 |
| 6. | <i>Mentha spicata L.</i> | ሚንት | Hawassa, Debere Zeit | Fusarium wilt, Rust | Twist and curl leaf, stunted plant, Yellow brown pustules undersides of leaves | 40-50 | 20-25 |
| 7. | <i>Erucio sativa</i> | ሮኩላ | Hawassa, Debre Zeit | Botrytis, downy mildew | Gray mold, downy mold on underside | 20 | 10 |
| 8. | <i>Organum vulgare</i> | አርጋፍ | Hawassa, Debre Zeit | Rhizoctonia, rust, Botrytis | Root rot, wilting, leave spot, gray mould | 30 | 15 |
| 9. | <i>Rosmarinus officialis L</i> | ሮዝማሪ | Debre Zeit | Rust | Yellow to brown spot lesion, | 50 | 25 |
| 10. | <i>Melissa officinalis</i> | ሌሞን ፓልም | Debre Zeit | Bacterial blight/ leaf spot | Discolored lesions, dark brown, angular necrotic spot | 20 | 10 |
| 11. | <i>Allium schoenoprasum</i> | ቻይቭ | Hawassa, Debre zeit | Botrytis blight, Downy mildew | Chlorosis, death of plant tissue, tip part yellowing | 30 | 15 |

4. Conclusion and Recommendation

The current survey conducted in four herb growing locations such as wondo Genet, Hawassa, Butajira and Debrezezet. The result revealed a total of ten different diseases on eleven medicinal and aromatic plants were recorded. In Wondo Genet, the major disease recorded on lemongrass, aloe vera, stevia and basil plants were rust, root rot and downy mildew. The severity ranges from 15% to 30% damage. Basil, lemongrass and sage were infected by downy mildew, rust and powdery mildew respectively in Butajira and the severity ranges from 10 to 20%.

In Hawassa, the major disease recorded on Mint, basil, argulla, organo and sage plants were wilt, downy mildew, powdery mildew, botrytis and rust. The severity ranges from 10% to 35% (Table 2). In Debre Zeith, the major disease recorded on basil, sage, roculla, areganon, mint, rosemary, lemongrass and lemon balm plants were downy mildew, virus, nematode, powdery mildew, botrytis, rust, bacterial blight. The severity ranges from 10% to 60%.

Therefore, further study should conduct the identification of the causing agents of the pathogen for all the recorded diseases of MAPs. In addition, control strategies should be planned for the major recorded disease of MAPs.

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Conflicts of Interest

The authors declare no conflicts of interest.

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