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Survey on Major Diseases of Chaba (*Piper chaba*)

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Chaba plants, belonging to the Piperaceae family, are susceptible to several diseases. It has become more vulnerable to disease infection due to the climate change. A comprehensive survey was undertaken from July 2021 to July 2022 in Khulna, Bagerhat, Jashore, Chuadanga, and

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Magura to identify the major diseases that affect chaba production. The research was conducted in farmers' fields, specifically focusing on 5 different areas where Chaba was cultivated predominantly. The survey identified four diseases, namely foot and root rot, leaf rot, leaf spot, and leaf rust, as important diseases in these areas, based on their occurrence. Dumoria, Khulna has the highest disease incidence. The disease incidence varied between 7.33% and 16.73%. Dumoria upazilas had the highest occurrence of foot and root rot (15-25%) as well as leaf rot (20-30%). While, Alomdanga upazila had the lowest incidence of foot and root rot (10-15%) and leaf rot (10-15%). The farmers in these regions consider these diseases to be a significant risk to the future cultivation and extension of Chaba in the southern portion of Bangladesh.

Keywords: Chaba; disease incidence; foot and root rot; leaf rot.

1. INTRODUCTION

Spices form an essential part of human consumption since the human race. As they have been continuously used from years to increase the quality of nutrition and also recognized for their preservative characteristics and medicinal properties [1]. Piper species belongs to the Piperaceae family which is considered to be among the most ancient of flowering plants growing in tropical regions, comprising of 13 genera [2]. Chaba (*Piper chaba)* is a flowering vine in the family Piperaceae that is native in India (Tripura, West Bengal), Bangladesh (Khulna-Jessore), Malay Islands and other warmer regions of Asia including Malaysia, Indonesia, Singapore and Sri Lanka [3]. It is a creeper type vine that grow with large trees and also spreads on the ground. It is used as spices in meat, fish and mutton curry and other famous dishes. *Piper chaba* is called Chui Jhal or Choi Jhal in the Khulna-Jashore region of Bangladesh, Tripura (India) and West Bengal (India). People in Bangladesh's south-western districts like Khulna, Jessore, Bagerhat, Satkhira & Narail cut down the stem, roots, peel the skin and chop it into small pieces and cook them with meat and fish, especially with mutton. The spicy pungent flavor of Choi Jhal is a year-round additive spice. In Indian states of West Bengal and Tripura people use this spice similarly with exception to some people in southern Bengal who prepare a complete dish with the Chaba as the base ingredient, it is very spicy. It is a relatively expensive spice in Bangladesh, and the roots are usually more expensive than the stems because of their stronger aroma. During the period of chilis crisis due to natural calamities or outbreak of diseases, chaba can be used as a supplement of chili.

In Bangladesh and India, this plant has many more medicinal values in a wide variety of diseases including asthma, bronchitis, piles, colic pain, dyspepsia and gastralgia [4-8]. Studies have shown that chemicals (pipernonaline, guineensine etc) isolated from the Chaba plant have potential anti-inflammatory, antibacterial, antifungal and analgesic activities. Piperine has also been shown to have certain serious toxicities such as antifertility [5] respiratory paralysis, hemorrhagic necrosis, urinary bladder and adrenal glands [9]. Leaves and bark are used for diabetes, malaria and jaundice. The arial part of this plant has also exhibited anti-diarrhoeal, anti-hypertensive, carminative, diuretic, stimulant, expectorant, and smooth muscle relaxant properties [6]. The bark is used for making an external application for pain and chest. The fruits are applied as a gastro-protective, anti-flatulent, appetizing property, and also possesses cholesterol lowering properties [10]. Stem is used to reduce post-delivery pain in mothers and also fruitful in rheumatic pains [11]. The urging for more drug candidates from this kind of natural sources is continuously increasing day by day. Different pest and disease causes severe yield loss of chaba. In Bangladesh very few research works has been done with Chaba. A Field survey helps in estimation of crop loss in field conditions, identifying hotspots and disease free areas as well as to relate correlating factors for disease outbreaks. For this reason, the present study was undertaken to identify major disease of chaba [12-14].

2. MATERIALS AND METHODS

2.1 Study Area

A survey was conducted in in major Chaba growing areas of Khulna, Bagerhat, Jashore, Chuadanga and Magura districts of Bangladesh during july, 2020 to july 2021 to find out major disease of Chaba (Fig. 1). The disease incidence (DI) was monitored to find major diseases of Chaba. Fig. 1 shows the locations where the sampling was conducted. Ten Chaba fields were

randomly selected from each Upazila. The details of survey areas are presented in Table 1.

2.1.1 Description of the locations

2.1.1.1 Dumuria

Dumuria is an upazila of Khulna district which is situated at geographical coordinates 22.8083°N and 89.4250°E inside the Agro Ecological Zones (AEZs) of 11. The upazila has a total area of 45,423 hectares land, 71,909 houses and a population of 305,675. The soil composition consists mostly of clay, with the presence of silt and organic material [15].

2.1.1.2 Botiaghata

Botiaghata is an upazila of Khulna district which is situated within the 11th AEZs, with geographical coordinates 22.7417°N and 89.5167°E. Total area of the upazila is 23622 ha. There were 40,779 households and a population of 171,691 in Batiaghata upazila [15]. The upazila lies in the physiographic unit of high ganges alluvium floodplain and ganges tidal floodplain. Major land type in this upazila is medium highland to medium lowland and the textural class is mainly clay loam.

2.1.1.3 Fakirhat

Fakirhat is an upazila of Bagerhat district which is situated within AEZs of 13 with coordinates comprising 22.7806°N and 89.7083°E. Total area of the upazila is 15890 ha. The total population of Fakirhat Upazila was 137,789, living in 33,133 households [15].

2.1.1.4 Manirampur

Manirampur is an upazila of Jashore district which is situated in the geographical coordinates of 23.0167°N latitude and 89.2333°E longitude, falling under AEZs 11. The upazila has a total area of 44,491.49 hectares with a total of 101,239 homes and a population of 417,421 [15]. The primary soil types consist mostly of non-calcareous dark grey floodplain soils, peat, and non-calcareous brown floodplain soils [16].

2.1.1.5 Alamdanga

Alamdanga is an upazila of Chuadanga district which is situated at geographical coordinates 23.7583°N and 88.9500°E within AEZs 11. The upazila has a total area of 36,528 hectares, with a population of 345,922 and a total of 86,299 households [15]. The soil types primarily consist of calcareous dark grey floodplain soils and calcareous brown floodplain soils [16].

2.1.1.6 Magura sadar

Magura Sadar is situated in the geographical coordinates of 23.4875°N and 89.4208°E within AEZs 11. The upazila has a total area of 40,158 hectares, with a cultivated area of 15,835 hectares. According to BBS, [15] magura Sadar Upazila has a total of 86,162 houses and a population of 380,107. The majority of soil types are Calcareous Alluvium and Non-calcareous dark grey floodplain soils [16]. The primary crops cultivated in the region are paddy, jute, wheat, mustard, gram, masuri, sugarcane, and other vegetables.

2.2 Disease incidence

Hundred fields were chosen for sampling throughout the Chaba growing season. During the survey 10 sampling points were picked from a field. Hence, 100 plants from each field were gathered for the purpose of observation. The calculation of disease incidence was assessed by evaluating the symptoms present on the surface of both the leaves and roots and it was reported as a percentage. A total of one hundred plants were selected at random and the percentage of disease incidence was determined using the method established by Tipu et al., [17].

% Disease incidence (DI) = (Number leaves or fruits infected × 100)/Total number of leaves or fruit counted.

Table 1. Location of surveyed area

Name of the district	Name of the upazilla	AEZ	Latitude (N)	Longitude (E)
khulna	Dumoria	11	22.7661	89.4446
	Botiaghata	11	22.7483	89.4899
Bagerhat	Fakirhat	13	22.7799	89.7128
Jashore	Monirampur	11	22.9889	89.2352
Chuadanga	Alamdanga	11	23.7613	88.9431
Magura	Magura sadar	11	23.4884	89.4025

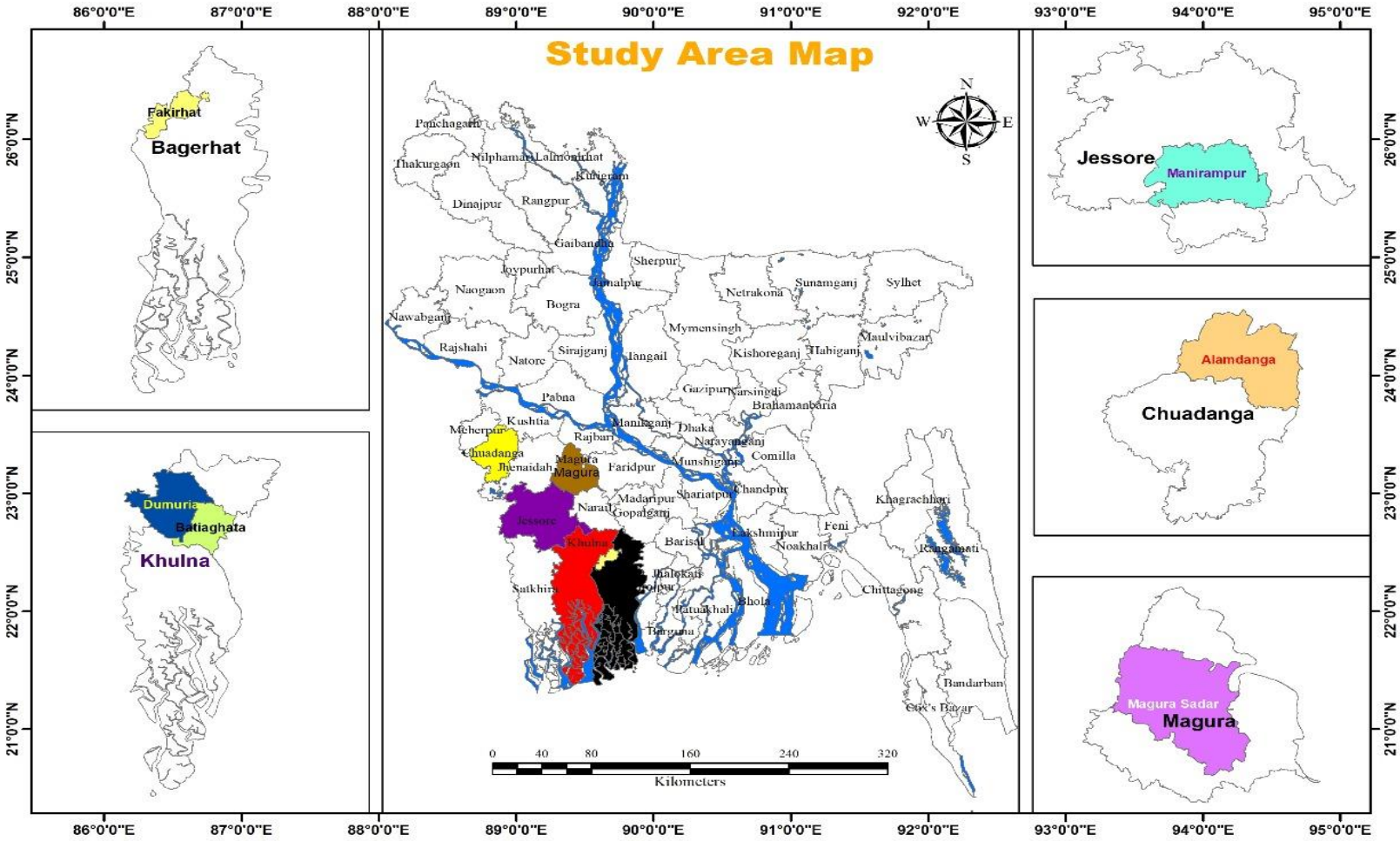

Fig. 1. Location map of the study area in Bangladesh

3. RESULTS AND DISCUSSION

Four different types of disease were observed viz. foot and root rot, leaf rot, leaf spot and leaf rust during the survey. Those diseases were identified by visual appeared of symptoms.

3.1 Identified Disease: Foot and Root Rot

Observed symptoms: At the primary stage of infection Leaf became pale, discolored and dies. Whitish colony mycelium was seen on the stem and roots (Fig. 2). Brown-colored mustard-like sclerotia were seen on the infected stem and soil near the vines. The stem portion showed the rotting of tissues at the plant of attack, and the plant showed dropping of the leaves and withering, finally dry up. Ton et al., [18] also detected this disease that when the upper part of pepper vine shows performance as leaf yellowing, wilting and dropping.

Fig. 2. Foot and root rot of Chaba

3.2 Identified Disease: Leaf Rot

Observed symptoms: The first symptoms were small, light to dark green, circular to irregular-shaped water-soaked spots. Lesions began to develop near the leaf tips or edges and expand rapidly into large, dark brown or black lesions which appearing greasy. Leaf lesions surrounded by a yellow chlorotic halo. Kifelew and Adugna, [19] also reported that dark brown water-soaked lesion was produced on the leaf by leaf rot disease.

3.3 Identified Disease: Leaf Spot

Observed symptoms: Symptoms initiated on lower or older leaves. Initially small, black, circular spots which later enlarge and concentric and covered with a yellow halo. The affected leaves turn pale yellow and dry up with large black dots in the center of the spots. Leaf spot black pepper also reported by Biju et al., [20] in all growing area in India.

3.4 Identified Disease: Leaf Rust

Observed symptoms: Symptoms was circular or oval, orange pustules on the upper surface of infected leaves. The spores within those pustules were easily dislodged and cover hands and clothing with an orange dust. According to Nourou et al., [14] Leaf rust symptoms are characterized by rusty brown-orange spots of circular shape with leaves showing number of lesions.

Fig. 3. Leaf rot of Chaba

Fig. 4. Leaf spot of Chaba

Fig. 5. Leaf rust of chaba

Table 2. Incidence of major diseases of Chaba in five districts of Bangladesh

Name of the district	Name of the upazilla	Major disease	Disease Incidence (%)
khulna	Dumoria	Foot and root rot	15-25
		Leaf rot	20-30
		Leaf spot	15-20
		Leaf rust	0-5
	Botiaghata	Foot and root rot	15-20
		Leaf rot	20-25
		Leaf spot	15-20
		Leaf rust	0-5
Bagerhat	Fakirhat	Foot and root rot	15-20
		Leaf rot	15-20
		Leaf spot	10-15
		Leaf rust	0-5
Jashore	Monirampur	Foot and root rot	10-15
		Leaf rot	15-20
		Leaf spot	10-15
		Leaf rust	0-5
Chuadanga	Alamdanga	Foot and root rot	10-15
		Leaf rot	10-15
		Leaf spot	10-15
		Leaf rust	5-10
Magura	Magura sadar	Foot and root rot	15-20
		Leaf rot	15-25
		Leaf spot	10-15
		Leaf rust	10-15

3.5 Disease Incidence (%)

The disease symptoms observed in different location are presented in Table 2. The results indicated that the incidence (15-30 %) of leaf rot followed by foot and root rot (10-25) % was high in most of the districts. The highest incidence of foot and root rot (15-25%), leaf rot (20-30%) was found from Dumoria, Khulna and the lowest incidence of foot and root rot (10-15%), leaf rot (10-15%) was found from Alomdanga, Chudanga districts. Molla, [21] also reported that leaf rot and foot and root rot of betel vine are two most prevalent diseases in the different betel vine growing areas of Bangladesh. According to jahan et al., [22] Foot and root rot of betel vine was recorded as a common disease in all the surveyed areas of kushtia. Foot rot caused by *P. capsici* Leonian, is an important disease of black pepper causing a yield loss of 10-15% in other countries [23]. About 12- 16% vine death has been reported in Chikmagalur and Shivamogga districts in Karnataka, India [24]. Similarly major important diseases of black pepper in Malaysia have been identified as Phytophythora foot rot disease [25,26].

4. CONCLUSION

From the above survey four diseases (foot and root rot, leaf rot, leaf spot and leaf rust) has been identify by visual examination of the symptoms from different Chaba growing areas of Bangladesh. Further study will be needed to identify the pathogen of these diseases. Molecular techniques should be used for the conformation of the pathogen.

DISCLAIMER (ARTIFICIAL INTELLIGENCE)

Author(s) hereby declare that NO generative AI technologies such as Large Language Models (ChatGPT, COPILOT, etc.) and text-to-image generators have been used during the writing or editing of this manuscript.

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COMPETING INTERESTS

Authors have declared that no competing interests exist.

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