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Research Article

IDENTIFICATION OF SOYBEAN DISEASES IN ASSAM

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ABSTRACT

Observations on incidence of diseases were made from soybean fields in Assam during the year 2018. Seed rot (*Pythium*, *Phytophthora*), Seedling mortality (*Phytophthora, Rhizoctonia, Pythium*) and Root & lower stem decay (*Fusarium, Rhizoctonia, Phytophthora*) were common during rainy days viz. July 25th to until August 2nd week. Collar rot (Coll.R.) observed during August 15th Onward at seedling to Vegetative growth stage of the crop. Weather data revealed that in the month of July- August maximum rainfall was experienced resulting in severity of many diseases. Among foliar diseases Alternaria leaf spot appeared during first week of September vegetative growth stage of the crop .Wilt complex was observed August 25th Onward (high rainfall experienced) at vegetative growth stage of the crop. Similarly Rhizoctonia Aerial Blight (RAB) observed at vegetative growth stage of the crop during September 1st week onward. Cercospora leaf spot (CLS) and Pod Blight[PB (Ct)] were noticed at flowering and pod formation stage viz. September 25th onward where intermittent rainfall was experienced by the crop. Soybean yellow mosaic virus (YMV) and Bacterial blight (BLB) observed during 15th September onward with intermittent rainfall at Vegetative and flowering stage of the crop.

INTRODUCTION

Among different production constraints in soybean production, the most serious being diseases and therefore identification of these diseases is vital. Anthracnose, bacterial diseases, brown spot, charcoal rot, frog eye leaf spot, Fusarium root rot, pod and stem blight, Purple seed stain & Cercospora leaf blight, Rhizoctonia aerial blight, Sclerotium blight, Seedling diseases, Soybean rust, Virus diseases and a few other diseases have been reported in India (Wrather *et al.,* 2006).Another report states major biotic stresses of soybean crop in India are diseases like yellow mosaic virus, rust, rhizoctonia, anthracnose, etc., and insect pests like stem fly, gridle beetle, and various defoliators (Agarwal *et al*., 2013). In India, the Asian soybean rust disease was first reported on soybean in 1951 (Sharma and Mehta, 1996). The occurrence of *Soybean mosaic virus* (SMV) in soybean grown in mid-hill condition of Meghalaya, India was confirmed by Banerjee *et al*, 2014. Frog eye leaf spot (*Cercospora sojina*), rust (*Phakospora pachyrhizi*), powdery mildew (*Microsphaera difJusa*) and purple seed stain (*Cercospora kikuchii*) were recorded in moderate to severe form is prevalent in North Eastern Hill region (Prasad *et al.,* 2003*)*.

Identification followed by prevention of the diseases is the first step towards management of diseases.Increased knowledge about the location and quantity of the pathogen in relation to weather conditions provides numerous benefits to growers and researchers by providing more accurate timing of disease management. Therefore this research will benefit the growers and researchers to increase the current knowledge on identification and determining incidence levels of different diseases of soybean in the fields of Assam. In the present investigation a survey in Assam was undertaken to find out the prevalence of the diseases on soybean crop.

MATERIALS AND METHODS

Observations on incidence and severity of various foliar and root diseases were collected during *Kharif*, 2018. The fields surveyed were at the beginning seed development, vegetative growth stage, flowering and pod formation stage. Observations were made during a single visit form the month of July 15th to October 25th 2018. For sampling purposes, within a field a roving survey was conducted following a zig-zag sampling pattern each of the fields. Disease survey was conducted on a weekly basis.

Visual observations for disease infection and collection of infected leaf /stem tissue samples were done. Foliar diseases were identified in the field by visual symptoms as described in previous literatures and by microscopic observation of causal

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pathogen. Plant samples were taken to the laboratory and pathogens were confirmed using a dissecting and/or compound microscope. For different diseases percent incidence for soil borne pathogens and percent disease index (PDI) for foliar pathogens following formula as wheeler(1969).

Percent Incidence= No of Plants infected/Total no.of plants x100

$$\text{Percent Disease Index} = \frac{\text{Sum of disease ratings}}{\text{Total no.of plants/leaves observed x max. scale}} \times 100$$

A total of 50 trifoliate leaves were collected from 10 sites (five leaves/site) from each field. Leaves were placed into plastic bags, stored in a cooler, and transported to the laboratory for processing. Leaf samples were assayed for *Soybean yellow mosaic virus* based on symptomatology.

RESULTS AND DISCUSSION

Observations on incidence of diseases of soybean were collected from soybean fields in Assam during the year 2018. Seed rot (*Pythium*, *Phytophthora*), Seedling mortality (*Phytophthora, Rhizoctonia, Pythium*) and Root and lower stem decay (*Fusarium, Rhizoctonia, Phytophthora*) was common during rainy days viz. July 25th to until August 2nd week. Collar rot (Coll.R.) observed during August 15th Onward at seedling to Vegetative growth stage of the crop. Weather data revealed in July August maximum rainfall was experienced due to which these diseases occurred. Among foliar diseases Alternaria leaf spot appeared during first week of September vegetative growth stage of the crop. Wilt complex was observed August 25th Onward (high rainfall experienced) at vegetative growth stage of the crop. Similarly Rhizoctonia aerial blight (RAB) observed at vegetative growth stage of the crop during Septermber 1st week onward. Cercospora leaf spot(CLS) and Pod Blight[PB (Ct)] were occurred at flowering and pod formation stage viz. September 25th onward where intermittent rainfall was experienced by the crop. Soybean yellow mosaic virus (YMV) and Bacterial blight (BLB) observed during 15th September onward with intermittent rainfall at Vegetative and flowering satge of the crop (table 1,3 & Fig 4).

Seed and seedling diseases of soybean in Assam

Seed and seedling diseases are basically soil borne diseases of soybean in Assam were found to be significant problems. Infection decreased plant populations that result in replanting of the crop during Kharif, 2018. Pathogens that were identified to be associated with seed and seedling diseases were *Fusarium*, *Rhizoctonia*, *Phytophthora*, and *Pythium*(fig.1). Rotting of seeds occurred before germination and seedling death caused great problem in soybean cultivation. This happened due to very wet soil as inundation occurred by heavy rainfall during the month of July and August (fig.4& table 3). Different seedling diseases may cause different symptoms. Damping-off is generalized name for seed-soil- borne pathogens causing seed rot or death of seedlings prior to emergence or death of seedlings following emergence (fig.1).

Seeds and seedlings infection was due to Pythium prior to emergence and caused pre emergence damping-off under wet conditions. The characteristic symptom of Pythium infections was soft, brownish-colored, rotting tissue (fig1.A,B). Phytophthora infection was exacerbated by flooding of fields after seeding has occurred. The pathogen survives long-term in the soil as hardy oospores. Infection of seedlings resulted in damping off. Symptoms of infection of older plants include lesions beginning at the soil line and extending up the stem, yellow/chlorotic leaves, wilting, reduced vigor, reduction in root mass and death (fig1.C, D).

Pythium causes symptoms similar to Phytophthora in seedlings, and can only be distinguished by laboratory examination. Although Pythium causes most damage to seeds and seedlings (fig1.A,B)., roots of established plants can be rotted and plants may be stunted. The results are in conformity with, Hershman, 2011; Kim *et al*., 2014)

Rhizoctonia damaged seeds and plants prior to or after emergence. In seedlings a firm, rusty-brown decay or sunken lesion on the root or on the lower stem was observed.*Fusarium* was also a common pathogen that damaged seeds and seedlings. It produced light to dark brown lesions on roots that spread over much of the root system and appeared shrunken. Similar observation on Fusarium infection to soybean seed and seedlings were observed by Díaz Arias *et al*., 2013a and 2013b; Broders *et al.,*2007 and Rhizoctonia infection onto seedlings were observed by Bowman *et al.,*1989(fig1.E,F,G,H,I).

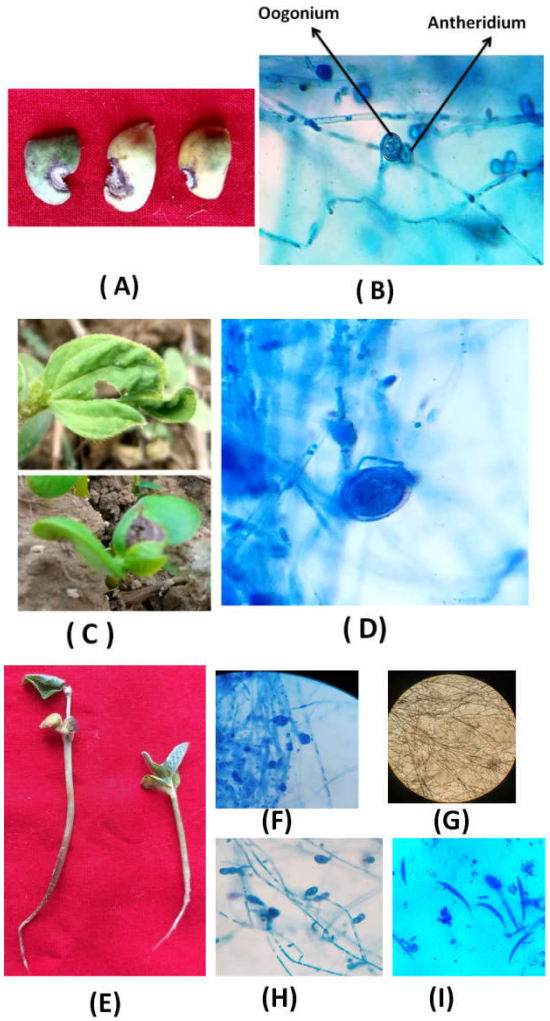

Fig 1 Seed and seedling diseases of soybean ;(A) infection on cotyledon leaf ,(B) Oomycetes fungi showing oogonium and antheridium, (C) Infection at 2-3 leaf stage of soybean crop due to Phytophthora spp.

Foliar and root diseases of soybean in Assam

Alternaria leaf spot (Alternaria sp.)

A brown necrotic spots with concentric rings appears on foliage which coalesces and form large necrotic areas. Inected seeds appear small and shrivlled. A dark irregular spreading sunken area occurs on seeds (fig2.A,B,C,D). The symptoms are in conformity as described by Kumar *et al.,* 2015; Bhosale *et al.,*2014.

Cercospora leaf spot (CLS)- Cercospora spp

Leaf spots sub-orbicular to angular, small, 0.5-1 mm wide, often confluent and become irregular patches, up to 10 mm wide, later covering the whole leave surface, pale brown to tan or grey center with a reddish brown to purple margin (fig2. J,K). Similar observations were reported by Grau *et al*., 2004 and Philips,1999. Symptoms often appear during reproductive stages as light purple areas on leaves later on expanded and turn a darker purple to almost leathery brown, and finally necrotic leaves dropped prematurely.

Fusarium Wilt

Fusarium Wilting symptoms appeared as damping off, stunting, decreased vigor, chlorosis, and decreased root masses with brown discoloration and/or lesions on the roots and taproot. Severely infected plants may wilt and killed before flowering. Foliar chlorosis begins at the leaf margins and moves inward until leaves become chlorotic and defoliation occurs while petioles remain attached to the stems ***(fig2. E,F,G,H,I).*** Similar observation on Fusarium infection to soybean were observed by Díaz Arias *et al*., 2013a and 2013b; Broders *et al*., 2007.

Soybean yellow mosaic virus (YMV)-Mungbean yellow mosaic virus

In case of *Mung bean yellow mosaic virus (MYMV)* infection the characteristic symptom is conspicuous systemic bright yellow mottling of leaves. The yellow area are scattered or occur in indefinite bands along the major veins. The youngest and most rapidly growing leaves have shown the most severe symptoms (fig2. L).

The results of the symptomatic studies are in conformity with Haq *et al*., 2010.; Naghavi *et al*.,2008. It was observed that *Ageratum loustonianum* (Local name: Gondhua bon) *Ludueigia linifolia* (Local name: Long bon) were showing Mosaic symptom (fig2.Y, Z). Which may act as collateral host or alternate host for begomoviruses like *Mungbean yellow mosaic virus (*Duffus, 2003; Prajapat *et al*., 2014). These weed species may act as source of inoculums.

Bacterial blight (BLB)- Xanthomonas campestri pv. Glycinea

Bacterial blight can be identified by small, angular, translucent, water-soaked, yellow to light-brown spots on the leaves and petioles. As bacterial blight progresses, affected leaf tissues dry out, turn reddish-brown to black, and become surrounded by water-soaked margins bordered by yellowish-green halos (fig2.M,N). In advanced stages, lesions enlarge and their interiors tend to produce large, irregularly shaped dead areas. cool, wet weather favours the disease as per previous reports. Initial infection of soybeans occurs when bacterial cells are carried by splashing or wind-driven water droplets from plant residue on the soil surface to the leaves. These results are in conformity with Jones and Fett, 1987; Hokawat and Rudolph,1993; Kaewnum *et al*, 2005; Kim *et al*,2006.
Rhizoctonia aerial blight (RAB)

Infected leaves appear as water soaked at first instance. They soon take on a greenish brown to reddish brown appearance. Dark brown sclerotia were formed on leaves and patioles (fig2.O, P,Q,R). Similar observations were reported by Fischer, 1987; Sonakar *et al*., 2014; Aghajani *et al*., 2000. Humid and cool (24-32°C) temperature are favourable for disease (Aghajani *et al*., 2000).

Anthracnose /Pod Blight [PB (Ct)]- Colletotrichum dematium var. truncatum

Infected seeds become shriveled, mouldy and brown. Laterally the infected tissues are covered with black fruiting bodies of the fungus. Under high humidity symptoms on leaves are veinal necrosis and premature defoliation occurs (fig2.S,T,U). Fruiting bodies also appear on stems. The results are in conformity with Subedi, 2015 and Subedi *et al*., 2016.

Table 1 Incidence of soybean diseases in Assam during *Kharif*, 2018

Sl. No.	Name of the disease	Pathogen	Percent Disease incidence	Period of occurrence	Crop growth stage
1.	Seed rot	Pythium, Phytophthora	40-50 (due to submerged water)	July 25th Onward	Beginning seed development
2.	Seedling mortality (Damping off/seedling blight)	Phytophthora, Rhizoctonia, Pythium	20-30	August 1st week Onward	Seedling
3.	Root and lower stem decay	Rhizoctonia, Phytophthora, Fusarium	20-30	August 2nd week Onward	Seedling
4.	Alternaria leaf spot	*Alternaria* sp.	1-3	1st week of September	Vegetative growth stage
5.	Cercospora leaf spot(CLS)	*Cercospora* sp.	15-20	September 25th onward	Flowering and pod formation
6.	Wilting/blight / Sudden death syndrome (SDS)	*Fusarium* sp. or *Rhizoctonia* sp.	5-10	August 25th onward	Vegetative growth stage
7.	Soybean yellow mosaic virus(YMV)	*Mungbean yellow mosaic virus*	1-15	15th September onward	Vegetative growth and flowering
8.	Bacterial blight (BLB)	*Xanthomonas campestri* pv. *glycinea*	10-20	15th September onward	Vegetative growth and flowering
9.	Collar rot (Coll.R.)		20-30	August 15th Onward	Seedling to Vegetative growth stage
10.	Rhizoctonia aerial blight (RAB)	*Rhizoctinia solani*	30-40	September 1st week onward	Vegetative growth stage
11.	Pod Blight[**PB (Ct)]**	*Colletotrichum dematium* var. *truncatum*	20-30	September 25th onward	Flowering and pod formation

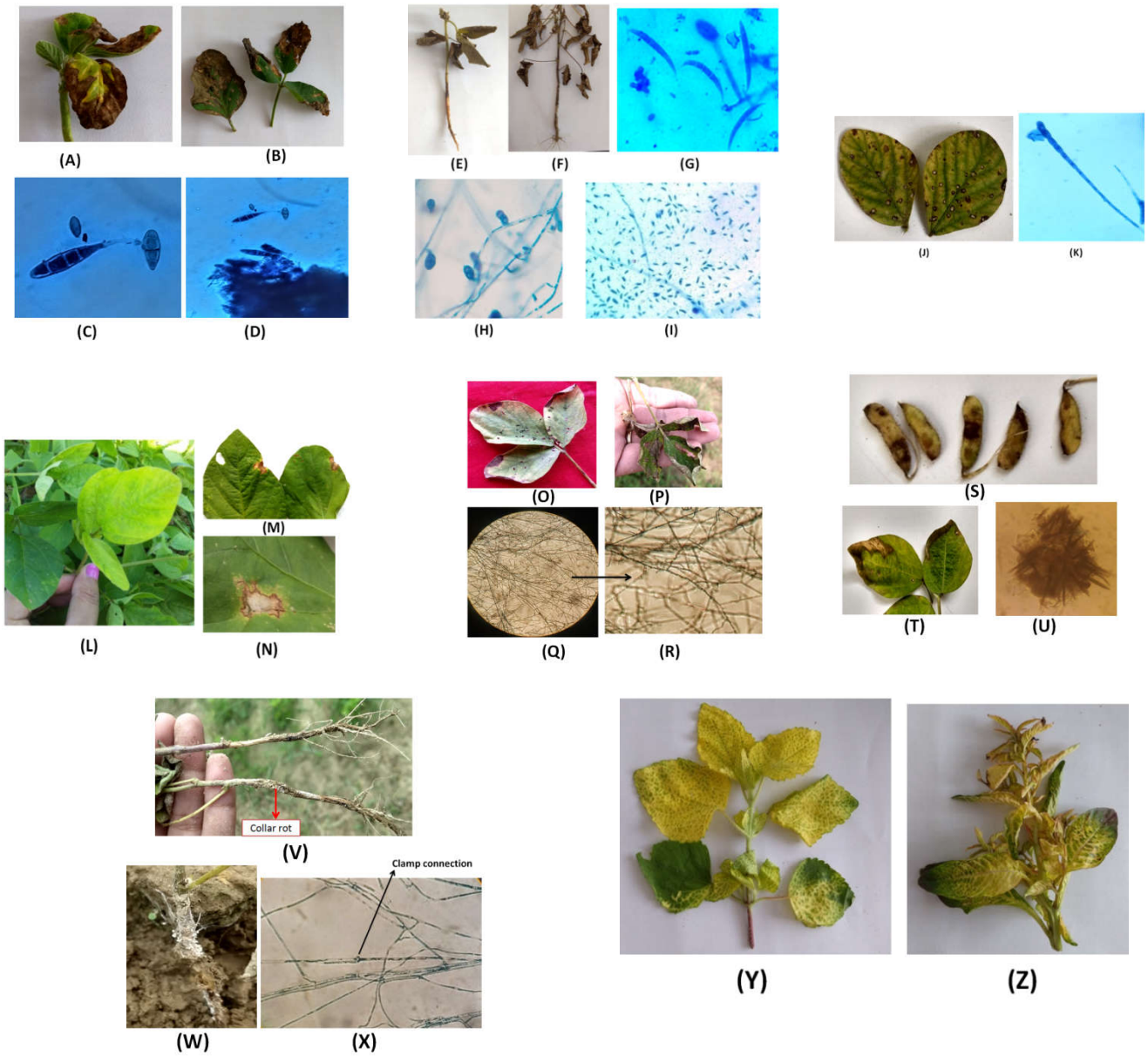

Fig 2. Diseases of soybean crop in Assam :- **A,B:** Alternaria leaf spot of soybean;**C,D**: Microscopic observation of Alternaria spore; **E,F**: Wilting/blight / Sudden death syndrome (SDS) due to Fusarium infection;**G**: Sickle shaped condia of *Fusarium* sp.**;H:** Chlamydospore of *Fusarium* sp observed under microscope;**I**: Microconidia of *Fusarium* sp observed under microscope; **J**: Cercospora leaf spot of soybean; **K**: Cercospora spore observed under microscope; **L**: Yellow Mosaic of soybean ; **M,N**: Bacterial leaf spot with yellow hallow and bacterial pustules; **O,P**: Symptoms of Rhizoctonia Aireal blight ;**Q,R**: Hyphae of *Rhizoctonia spp*. under microscope showing right angles; **S,T**: Symptoms of Pod blight caused by *Collatotrichum spp*.;**U:** *Colletotrichum* spp.fruiting bodies (acervulii); **V,W**: Collar rot of soybean showing sclerotia at the collar region of the plant; **X**: Mycellia of Scherotia spp. observed under microscope showing clamp connections; **Y**: weed *Ageratum loustonianum* (Local name: Gondhua bon)showing Mosaic symptom ; **Z**: weed *Ludueigia linifolia* (Local name: Long bon)showing Mosaic symptom

Collar rot (Coll.R.)-Sclerotium rolfsii

Infection occurs at or just below the soil surface. Yellowing or wilting of plants is the first symptom. Leaves turn brown, dry and often cling to dead stem. Numerous tan to brown spherical sclerotia form on infected plant material (fig2.V, W, X). The results are in conformity with Belkar *et al*., 2013; Deb and Dutta, 1991.

CONCLUSION

Our findings contributed to the understanding of pathogenic organisms associated with soybean in Assam, which is one of the most important oil seed crop in India.

After carrying out the survey for disease incidence soybean in Assam has been identified as disease stressed crop. There were very few reports of North East India, which explained disease occurrence in soybean. Our study also showed interesting fact about weather co-relation with pathogenic microbes. Comprehensively analyzing the relationship between crop disease and weather conditions, we can draw with the conclusion that due to heavy rain during the month of July - August there is occurrence of most of the fungal diseases. Results generated by the field observation and microscopic study will be helpful in increasing current understanding on identification and determining disease incidence levels in field for growers and researchers for taking up management strategies against the diseases.

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