Survey of Major Diseases in Mitha Pata variety of Betelvine (Piper betle L.) under Coastal Saline Zone of West Bengal, India

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A B S T R A C T

Fixed boroj survey was conducted during 2016 & 2017 in Mitha pata variety of Betelvine across four Blocks of South 24 Parganas District in the Coastal Saline Zone of West Bengal, India. Among the four diseases surveyed, highest incidence of Sclerotium collar rot (SCR) and maximum severity of Phytophthora leaf rot (PLR), Colletotrichum leaf spot (CLS) and Xanthomonas leaf spot (XLS) was recorded as 17.67±3.18%, 14.40±0.46%, 6.40±0.46% and 9.33±1.54%, respectively. Kakdwip Block showed consistently higher incidence of SCR (mean incidence 12.00±0.99%), whereas severity of leaf rot and leaf spots were maximum in Namkhana (mean PDI 10.00±0%0.71) and Patharpratima (mean PDI of CLS 3.55±0.61% and XLS 4.67±0.82%), respectively. Where collar rot was mostly confined to the summer months (March to June), the leaf rot and leaf spot diseases were more prevalent in rainy season (July to October).

Introduction

Betelvine (Piper betle L., Family: Piperaceae) is an important cash crop in West Bengal, where it is cultivated in 19,455 ha area by approximately 5 lakh farm families (Guha and Jain, 1997; Anonymous, 2015). A small boroj of even 10-15 decimals may provide considerable net profit for maintaining a family of five members and can act as a ‘household bank’, since the leaves can be plucked every week and sold straight in the market as and when liquid cash is required (Jana, 1995).

Out of 100 varieties of this crop cultivated around the world, 40 are found in India and 30 in West Bengal (Guha, 1997). The Coastal
Saline Zone of West Bengal holds an important position in Betelvine cultivation, sharing 46% and 49% of the total area and production, respectively, in the State. This zone, specially the Sagar island in South 24 Parganas District, is also famous for growing Mitha pata variety of Betelvine, which is admired for its fennel-like fragrance, sweet taste and low fibre content, both in national and international market.

In sub-tropical areas, Betelvine is cultivated inside a specially constructed shade house, known as ‘boroj’, to provide the crop a prerequisite microclimate. But the mild temperature, diffused light, high humidity and moist soil, prevailing inside the boroj, are also congenial for the growth and build up of several pathogens (Sengupta et al., 2011). Among all diseases, the foot rot & leaf rot (*Phytophthora parasitica*), leaf spot (*Colletotrichum capsici*), bacterial leaf spot (*Xanthomonas axonopodis pv. betlicola*) and collar rot (*Sclerotium rolfsii*) are the most damaging to this perennial creeper. The *Sclerotium* collar rot is identified as darkening of collar region of the vine followed by drooping of leaves and gradual wilting of the whole vine and presence of white, ropy mycelia and light to dark brown mustard like sclerotia of the pathogen over the lesion (Chattopadhyay and Maity, 1990).

In *Phytophthora* leaf rot, circular, black or brownish water soaked spots are observed on leaves, rapidly increasing in size and coalescing to each other leading to rotting of entire leaf (Dastur, 1935). Whereas, in case of *Colletotrichum* leaf spot, circular to irregular and light to dark brown spots, surrounded by yellow halo, develop on leaves (Maity, 1977). In case of *Xanthomonas* leaf spot, brown spots, surrounded by translucent water soaked areas on the lower leaf surface and yellow halo on the corresponding upper surface are found that remain delimited by leaf veins (Balasubrahmanyam et al., 1994, Bhattacharya et al., 2012). There are reports of 5-90% crop loss due to foot rot (Dasgupta et al., 2008), 30-100% loss due to leaf spot and leaf rot (Maity and Sen, 1979) and 25-90% loss due to collar rot disease (Maiti and Sen, 1982).

The present study was taken up to know the seasonality of four diseases in Mitha pata variety of Betelvine in South 24 Parganas District, under the Coastal Saline zone of West Bengal and record their degree of incidence and severity.

**Materials and Methods**

**Survey of boroj**

‘Fixed Boroz Survey’ was conducted in four major Betelvine growing Blocks, viz., Sagar Island, Namkhana, Kakdwip & Patharpratima of South 24 Parganas District, during 2016 and 2017. From each block, 5 villages and from each village, 3 boroz were selected for data collection. The mean of data from the three boroj were considered as village average. Disease incidence and severity were recorded at fortnightly interval, throughout the year. All the selected boroj were of same age (5 year old), where the Mitha pata variety was grown.

**Disease rating**

Rating of individual diseases was done by following the below mentioned rating scales:

**Disease incidence (%) of sclerotium collar rot (SCR)**

100 vines were marked randomly in each boroj. Number of infected vines was counted and percentage disease incidence (DI%) was calculated as, 

\[ DI = \frac{(\text{no. of infected vines}) \times 100}{(\text{total vines assessed})} \]
Disease severity of phytophthora leaf rot (PLR)

At first, disease rating was done at 0-5 point scale (0 = healthy leaf, 1 = upto 5%, 2 = 6-15%, 3 = 16-30%, 4 = 31-50% and 5 = above 50% leaf area covered) with 25 leaves, taken randomly from each boroj, as described by Goswami et al., (1993). Then, Percent Disease Index (PDI) was computed based on the formula as described by Wheeler (1969), viz., PDI = (sum of all disease rating) x 100/(total no. of observation) x (maximum rating).

Results and Discussion

All the surveyed Blocks showed incidence of the four major diseases under study. However, a considerable variation was observed in seasonality and severity of the diseases across the locations.

Disease severity of colletotrichum leaf spot (CLS)

At first, the disease rating was done at 0-5 point scale (0 = no or a few lesion on leaf, 1= upto 10%, 2 = 11-25%, 3 = 26-50%, 4 = 51-75% and 5 = above 75% leaf area affected) from 25 leaves, taken randomly from each boroj as described by Goswami et al., (2002). Then, Percent Disease Index (PDI) was computed based on the formula as described by Wheeler (1969).

Disease severity of xanthomonas leaf spot (XLS)

At first the disease rating was done at 1-3 point scale (1= 1-3 spots, 2 = 4-6 spots and 3 = more than 6 spots) from 25 leaves taken randomly from each replication as described by Tripathi et al., (1984). Then, Percent Disease Index (PDI) was computed based on the formula as described by Wheeler (1969).

The data were subjected to box-plot analysis to get a summarized distribution of disease incidence and severity data, based on minimum, first quartile (25th percentile), median (50th percentile), third quartile (75th percentile) and maximum values of the data.

Seasonality of betelvine diseases

Sclerotium Collar Rot (SCR) was found to occur in two distinct seasons during the year (Table 1). The first incidence was detected in the 3rd week of March, which continued to progress and reach its peak infestation during the month of June. There was no fresh infestation of this disease during the rainy months. A second incidence occurred during middle of October, after recession of monsoon and continued to infect the crop upto middle of November, when the temperature started falling. The disease was clearly absent during the rainy and winter months. Several researchers reported that the collar rot pathogen Sclerotium rolfsii survive better at low soil moisture level than at high moisture (Harlapur, 1988; Kulkarni, 2007). However, Maity and Sen (1982) reported that foot rot in betelvine, caused by S. rolfsii, was more related to mean minimum temperature (> 22°C) than to rainfall.

Phytophthora Leaf Rot (PLR) & Xanthomonas Leaf Spot (XLS) were both prevalent during July to October whereas, Colletotrichum Leaf Spot (CLS) was found to occur during July to middle of January. The results corroborated with the findings of other researchers regarding seasonality of incidence of various leaf rot and leaf spot pathogens in Betelvine (Naik et al., 1990; Renubala and Dutta, 1991; Huq, 2011; Chakraborty, 2018). Marimuthu and Rabindran (1988) reported a positive correlation between infestation of Phytophthora spp. in Betelvine and rainfall, from Tamil Nadu.
**Disease incidence and severity**

Village level incidence of *Sclerotium* Collar Rot (SCR) varied from 6.67±0.88% to 17.67±3.18% in 2016 and from 5.67±0.88% to 15.33±1.45% in 2017 (Table 2). According to the pooled data of two year’s survey (Fig 1), mean disease incidence was highest in Kakdwip Block (12.00±0.99%) and lowest in Sagar (9.53±0.81%). However, the box-plot analysis revealed that both the lowest 25% and highest 25% of disease incidence were witnessed in Namkhana Block (Fig 2).

Hence, it can be concluded that the collar rot incidence was consistently in the higher range at Kakdwip Block (9.50±2.36% to 14.17±1.20%) in comparison to the Namkhana Block, where its incidence was highly variable (6.67±0.17% to 16.50±2.25%). Similarly, Palakshappa et al., (1986) recorded 35 to 39% incidence of this disease in Betelvne in Karnataka, whereas Singh and Chand (1972) and Maiti and Sen (1982) reported 42-62% loss in Madhya Pradesh and 25-90% loss in West Bengal, respectively. *Phytophthora* Leaf Rot was found to be more severe among the leaf rot and leaf spot diseases. Percent Disease index (PDI) of *Phytophthora* Leaf Rot varied from 1.60±0.46% to 14.40±0.46% in 2016 and from 1.60±0.46% to 9.33±0.71% in 2017 (Table 2). The mean PDI (pooled data) was highest in Namkhana Block (10.00±%0.71) and lowest in Patharpratima Block (3.23±0.54%). *Xanthomonas* leaf spot was next to *Phytophthora* leaf rot in severity during the rainy season whose PDI varied from 0.89±0.44% to 9.33±1.54% in 2016 and from 1.33±0.77% to 5.78±1.78% in 2017. The disease (XLS) was most severe in Patharpratima Block (pooled mean PDI 4.67±0.82%). The severity of *Colletotrichum* leaf spot varied from 0.53±0.53% to 4.60±0.46% in 2016 and 1.07±0.53% to 4.53±0.27% in 2017.

**Table 1** Seasonal incidence of major diseases of Betelvne

| Month     | *Sclerotium* Collar Rot (SCR) | *Phytophthora* Leaf Rot (PLR) | *Colletotrichum* Leaf Spot (CLS) | *Xanthomonas* Leaf Spot (XLS) |
|-----------|-------------------------------|-------------------------------|---------------------------------|-------------------------------|
| January   | -                             | -                             | +                               | -                             |
| February  | -                             | -                             | -                               | -                             |
| March     | +                             | -                             | -                               | -                             |
| April     | +                             | -                             | -                               | -                             |
| May       | +                             | -                             | -                               | -                             |
| June      | +                             | -                             | -                               | -                             |
| July      | -                             | +                             | +                               | +                             |
| August    | -                             | +                             | +                               | +                             |
| September | -                             | +                             | +                               | +                             |
| October   | +                             | +                             | +                               | +                             |
| November  | -                             | -                             | +                               | -                             |
| December  | -                             | -                             | +                               | -                             |

‘+’ represents presence of visible respective disease symptom and ‘-’ represents absence of visible respective disease symptom
### Table 2: Incidence and severity of major diseases of Betelvine in South 24 Parganas district under coastal saline zone of West Bengal

| Block     | Village                | DI (%) of SCR          | PDI (%) of PLR          | PDI (%) of CLS          | PDI (%) of XLS          |
|-----------|------------------------|------------------------|-------------------------|-------------------------|-------------------------|
|           |                        | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 | 2016 | 2017 |
| Sagar     | Khansaheb Abad         | 9.33±1.20             | 9.00±1.00               | 7.47±0.71               | 5.60±0.92               | 2.13±0.53               | 1.07±0.53               | 1.78±0.44               | 1.33±0.77               |
|           | Harinbar               | 11.33±1.67            | 11.67±1.20              | 8.27±0.96               | 6.13±0.71               | 1.07±0.71               | 1.33±0.71               | 2.22±0.89               | 1.78±1.18               |
|           | Bamankhali             | 9.00±2.89             | 8.33±2.33               | 9.60±1.22               | 7.73±0.96               | 1.87±1.16               | 1.60±0.92               | 1.33±0.77               | 2.67±0.77               |
|           | Rudranagar             | 9.67±1.20             | 10.33±1.20              | 7.73±1.62               | 5.87±1.41               | 3.47±0.27               | 1.87±0.96               | 1.78±0.89               | 2.22±1.18               |
|           | Haradhanpur            | 8.67±0.88             | 8.00±1.00               | 6.40±1.85               | 5.07±1.41               | 1.33±0.96               | 1.60±0.46               | 3.56±0.89               | 3.11±1.60               |
| Mean      |                        | 9.60±0.46             | 9.47±0.68               | 7.89±0.52               | 6.08±0.45               | 1.97±0.42               | 1.49±0.14               | 2.13±0.38               | 2.22±0.31               |
| Namkhana  | Narayanganj            | 14.33±0.67            | 13.67±0.33              | 11.47±0.71              | 9.07±0.27               | 3.73±0.71               | 2.13±1.07               | 2.67±1.33               | 3.56±0.44               |
|           | Debnagar               | 6.67±0.88             | 7.33±0.88               | 10.13±0.53              | 8.53±0.71               | 0.53±0.53               | 1.87±0.27               | 2.22±1.18               | 4.89±1.78               |
|           | Madanganj              | 9.67±1.45             | 9.00±1.53               | 10.93±0.53              | 9.33±0.71               | 4.00±0.80               | 2.67±0.27               | 5.33±0.77               | 3.56±1.18               |
|           | Namkhana               | 17.67±3.18            | 15.33±1.45              | 14.40±0.46              | 8.80±0.46               | 1.07±0.27               | 2.93±0.71               | 4.44±1.78               | 3.11±1.18               |
|           | Shibnagar Abad         | 7.67±0.88             | 5.67±0.88               | 9.60±1.67               | 7.73±1.62               | 1.60±0.46               | 2.13±1.16               | 4.89±1.18               | 4.00±2.04               |
| Mean      |                        | 11.20±2.09            | 10.20±1.85              | 11.31±0.84              | 8.69±0.28               | 2.19±0.71               | 2.35±0.20               | 3.91±0.62               | 3.82±0.30               |
| Kakdwip   | Shibkalinagar          | 11.67±1.86            | 10.33±0.88              | 9.87±0.71               | 8.53±0.71               | 2.93±0.71               | 4.53±0.27               | 2.22±1.18               | 1.78±0.89               |
|           | Bamnagar               | 14.67±0.33            | 13.67±2.73              | 6.13±2.63               | 8.80±1.67               | 5.07±0.27               | 3.20±0.92               | 3.11±1.18               | 2.67±1.33               |
|           | Akshayanagar           | 12.67±1.45            | 12.00±1.53              | 10.40±0.92              | 6.40±0.46               | 1.87±0.96               | 2.93±1.16               | 3.56±1.18               | 2.22±1.18               |
|           | Gangadharpur           | 13.33±1.20            | 12.67±2.03              | 7.47±0.96               | 5.87±0.96               | 2.40±0.46               | 4.27±0.96               | 4.44±1.18               | 3.56±1.18               |
|           | Budhakhalis            | 9.33±2.96             | 9.67±1.76               | 10.67±0.71              | 8.53±0.71               | 2.13±0.71               | 2.93±0.53               | 0.89±0.44               | 2.22±1.18               |
| Mean      |                        | 12.33±0.89            | 11.67±0.74              | 8.91±0.90               | 7.63±0.62               | 2.88±0.57               | 3.57±0.34               | 2.84±0.61               | 2.49±0.30               |
| Patharpratima | Keorakhalri        | 13.67±2.03            | 10.33±1.45              | 3.47±0.71               | 2.93±0.27               | 3.47±0.96               | 3.20±0.92               | 4.00±0.77               | 3.56±1.78               |
|           | Dakshin Raipur         | 11.33±0.33            | 10.67±2.03              | 2.67±0.27               | 3.20±0.46               | 5.07±0.53               | 4.00±1.39               | 6.67±0.77               | 4.44±1.18               |
|           | Digambarpur            | 11.00±1.53            | 12.33±1.45              | 5.07±1.62               | 5.87±0.96               | 1.07±0.53               | 1.87±0.71               | 3.11±0.44               | 1.78±0.44               |
|           | Dakshin Durgapur       | 12.67±1.45            | 13.00±1.15              | 2.40±0.46               | 1.60±0.46               | 4.80±0.80               | 2.40±0.92               | 9.33±1.54               | 5.78±1.78               |
|           | Uttar Mahendrapur      | 8.67±0.88             | 7.00±1.15               | 1.60±0.46               | 3.47±0.71               | 6.40±0.46               | 3.20±0.46               | 4.44±0.44               | 3.56±0.44               |
| Mean      |                        | 11.47±0.85            | 10.67±1.04              | 3.04±0.59               | 3.41±0.69               | 4.16±0.90               | 2.93±0.37               | 5.51±1.12               | 3.82±0.65               |

* Data represents mean ± Standard Error
Fig. 1 Mean disease incidence (DI) of *Sclerotium* Collar Rot (SCR) and mean PDI of *Phytophthora* Leaf Rot (PLR), *Colletotrichum* Leaf Spot (CLS) and *Xanthomonas* Leaf Spot (XLS) in four Blocks (pooled data). The error bar represents Standard Error.

**Box plot of Betelvine diseases**

Fig. 2 Box-plot, representing the median, quartiles and outliers of disease incidence (DI) of *Sclerotium* Collar Rot (SCR) and PDI of *Phytophthora* Leaf Rot (PLR), *Colletotrichum* Leaf Spot (CLS) and *Xanthomonas* Leaf Spot (XLS) in four Blocks.
The pooled data shows that the disease was most severe in Patharpratima Block (mean PDI 3.55±0.61%). Wasnikar and Nayak (1991) reported 4-60% severity of bacterial leaf spot in betelvine from Madhya Pradesh, whereas, 30-100% loss was recorded by Maity and Sen (1979) due to leaf spot and leaf rot.

The Mitha pata variety of Betelvine was found to be susceptible to the collar rot during the summer season (March to June) and to leaf rot and leaf spot diseases during the monsoon season (July to October).

The incidence of collar rot (SCR) disease was consistently at higher side in Kakdwip than in other Blocks. Whereas, in case of leaf rot (PLR) and leaf spot diseases (XLS & CLS), Namkhana and Patharpratima Blocks showed consistently higher severity, respectively.

All the diseases were present at a very low to moderate level in Sagar Block. Though all the surveyed blocks fall under same agroclimatic zone, there may be some differences in local microclimate, variability in pathogen, inoculum level and its perpetuation, agronomic management, plant protection measures and knowledge level among the farmers that might have caused variation in incidence and severity of the four diseases.

These findings may be helpful to construct a location specific disease management module to address different diseases in different season.

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